United States
Environmental Protection
Agency

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Alaska
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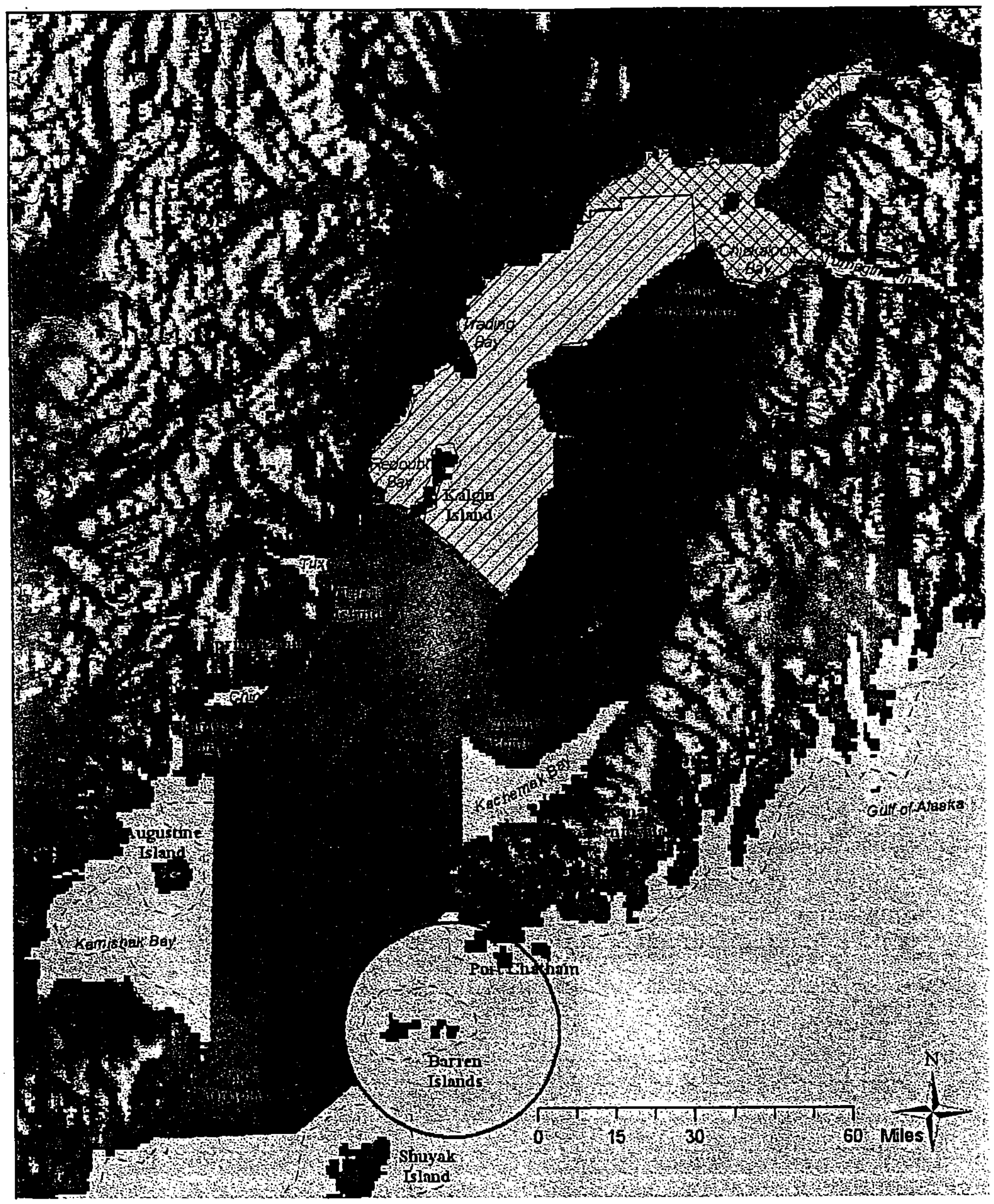
OCEAN DISCHARGE CRITERIA EVALUATION FOR THE COOK INLET NPDES PERMIT



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Prepared for:
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CONTENTS

ACRONYMS

AAC	Alaska Administrative Code
ACMP	Alaska Coastal Management Program
AMSA	Alaska Meriting Special Attention
AOGCC	Alaska Oil and Gas Conservation Commission
BAT	Best available pollution control technology economically achievable
bbl	barrel
BCT	Best conventional pollution control technology
BOD	biochemical oxygen demand
BPT	Best practicable control technology
CFR	Code of Federal Regulations
CMP	Coastal Management Plan
COD	chemical oxygen demand
CWA	Clean Water Act
CZMP	Coastal Zone Management Program
EFH	Essential Fish Habitat
ELG	effluent limitations guidelines
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FC	fecal coliform
GC/MS	gas chromatography/mass spectrometry
gpd	gallons per day
gpm	gallons per minute
HPC	Habitat of Particular Concern
ITL	Information to Lessee (clauses)
KPB	Kenai Peninsula Borough
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
OCS	Outer Continental Shelf
ODCE	Ocean Discharge Criteria Evaluation
ppm	parts per million
ppt	parts per thousand
SBF	Synthetic-Based Drilling Fluids
TSS	total suspended solids
UOD	Ultimate Oxygen Demand
USFWS	U.S. Fish and Wildlife Service
WBF	Water-Based Drilling Fluids

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1.0 INTRODUCTION

1.1 PURPOSE OF EVALUATION

The U.S. Environmental Protection Agency (USEPA) intends to reissue the National Pollution Discharge Elimination System (NPDES) General Permit for Oil and Gas Exploration, Development, and Production Facilities in state and federal Waters in Cook Inlet, Alaska. Section 403(c) of the Clean Water Act (CWA) requires that NPDES permits for such ocean discharges be issued in compliance with EPA's Ocean Discharge Criteria for preventing unreasonable degradation of ocean waters. The purpose of this Ocean Discharge Criteria Evaluation (ODCE) report is to identify pertinent information and concerns relative to the *Ocean Discharge Criteria* and discharges from oil and gas exploration, development, and production facilities.

EPA's *Ocean Discharge Criteria* (40 [Code of Federal Regulations (CFR)] CFR Part 125, Subpart M) set forth specific determinations of unreasonable degradation that must be made prior to permit issuance. "Unreasonable degradation of the marine environment" is defined (40 CFR 125.12[e]) as follows:

1. Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities

2. Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms

3. Loss of aesthetic, recreational, scientific, or economic values, which are unreasonable in relation to the benefit derived from the discharge

This determination is to be made on the basis of considering the following 10 criteria (40 CFR 125.122):

1. The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged

2. The potential transport of such pollutants by biological, physical or chemical processes

3. The composition and vulnerability of the biological communities that may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act (ESA), or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain

4. The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism

5. The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs

6. The potential impacts on human health through direct and indirect pathways

7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing

8. Any applicable requirements of an approved Coastal Zone Management Plan

9. Such other factors relating to the effects of the discharge as may be appropriate

10. Marine water quality criteria developed pursuant to Section 304(a)(1)

If the Regional Administrator determines that the discharge will not cause unreasonable degradation to the marine environment, an NPDES permit may be issued. An individual NPDES permit may be issued for distinct locations within Cook Inlet necessitating special consideration due to sensitivity or biological concern. If the Regional Administrator determines that the discharge will cause unreasonable degradation of the marine environment, an NPDES permit may not be issued.

If the Regional Administrator has insufficient information to determine, prior to permit issuance, that there will be no unreasonable degradation to the marine environment, an NPDES permit will not be issued unless the Regional Administrator, on the basis of the best available information, determines that all of the following are true:

1. such discharge will not cause irreparable harm to the marine environment during the period in which monitoring will take place.
2. there are no reasonable alternatives to the onsite disposal of these materials.
3. the discharge will be in compliance with certain specified permit conditions (40 CFR 125.122).

Irreparable harm is defined as "significant undesirable effects occurring after the date of permit issuance, which will not be reversed after cessation or modification of the discharge" (40 CFR 125.121[a]).

1.2 SCOPE OF EVALUATION

This document evaluates the impacts of discharges as provided for by the NPDES general permit proposed for oil and gas exploration, development, and production facilities in federal and state waters in Cook Inlet.

This document relies extensively on information provided in the *Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 Final Environmental Impact Statement* (MMS 2003); the proposed NPDES general permit; the proposed NPDES general permit fact sheet; the *Draft Biological Evaluation for the Cook Inlet NPDES Permit* (Tetra Tech 2006); the *Ocean Discharge Criteria Evaluation for the Forest Oil Osprey Platform, Redoubt Shoal Unit Development Project* (SAIC 2001); and the *Environmental Assessment for the New Source NPDES Forest Oil Redoubt Shoal Unit Production Oil and Gas Development Project* (SAIC 2002). For more detailed information concerning certain topics, where appropriate, this document will refer you to these publications. The information presented in this ODCE is a synthesis of the information in these documents in addition to findings published in scientific literature.

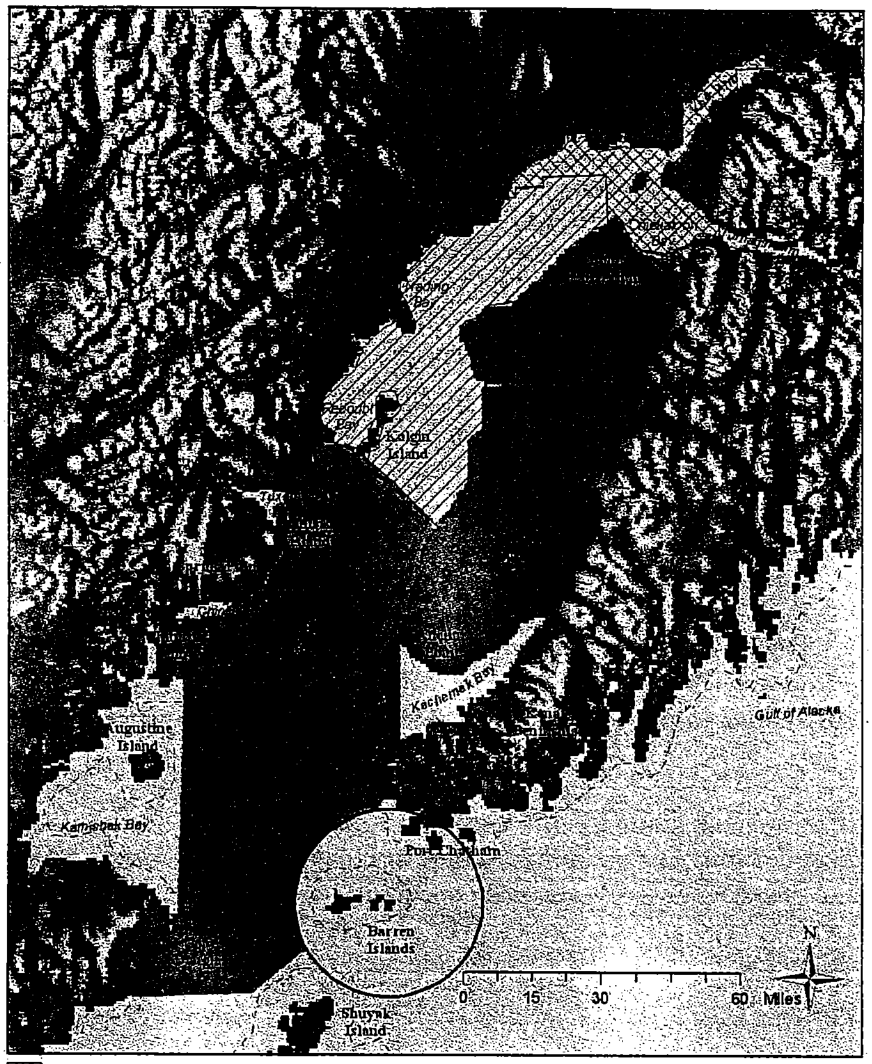
1.2.1 Area of Coverage of the Proposed NPDES General Permit and Applicability of this ODCE

This document evaluates the impacts of waste discharges as provided for by the NPDES general permit proposed for oil and gas extraction, development, and production facilities pursuant to Section 403(c) of the CWA. Section 403 applies to discharges into "offshore waters," the territorial sea, waters of the contiguous zone, or the oceans. As illustrated in Figure 1, territorial seas (and federal waters) are the waters south of Kalgin Island and are the subject of this ODCE. Waters north of Kalgin Island, including the location of all existing discharges, are considered coastal waters and are not considered in the ODCE.

The proposed NPDES general permit addresses discharges from three types of platform-based oil and gas operations: exploration, development, and production. A single facility can conduct development and production operations at the same time. A single facility, however, rarely engages in exploratory operations in conjunction with either development or production activities. The proposed NPDES general permit also addresses discharges from specified onshore facilities. These onshore facilities typically involve different discharges than platform-based operations.

The existing NPDES general permit covers oil and gas facilities in Cook Inlet north of a line extending between Cape Douglas (at 58°51′ latitude, 153°15′ longitude) on the west and Port Chatham (at 59°13′ latitude, 151°47′ longitude) on the east, except the prohibited areas described in section 1.2.2.

The proposed NPDES general permit expands the existing NPDES general permit's coverage area to include areas under the Minerals Management Service (MMS) Lease Sales Nos. 191 and 199, which lie outside the southern boundary of the existing NPDES general permit's coverage area.



Surface Access Restrictions
Boundary between Coastal Waters and Territorial Seas
Boundary between Territorial Seas and Federal Waters
Sugarloaf Island Exclusion Area
General permit will authorize discharges from exploration facilities and new source development and production facilities
General permit will authorize discharges from exploration facilities and development and production facilities
Proposed New Area of Coverage for which the general permit will authorize discharges from exploration facilities and new source development and production facilities.

Figure 1. Proposed NPDES permit areas.

In addition to the discharge prohibitions described above, the proposed NPDES general permit would prohibit discharges in the following areas:

- In Shelikof Strait south of a line between Cape Douglas (at 58°51′ N, 153°15′ W) on the west and the northernmost tip of Shuyak Island on the east (at 58°37′ N, 152°22′ W)
- Within 20 nautical miles of Sugarloaf Island as measured from a centerpoint at 58°33′ N and 152°02′ W
- Within the boundaries, or within 4,000 meters (expanded from 1,000 meters in the existing NPDES general permit) of a coastal marsh, river delta, or river mouth, or a designated Area Meriting Special Attention (AMSA), State Game Refuge (SGR), State Game Sanctuary (SGS), Critical Habitat Area (CHA), or National Parks. (The seaward edge of a coastal marsh is defined as the seaward edge of emergent wetland vegetation)

The Shelikof Strait area described above was outside of the existing NPDES general permit coverage area. The National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries) has designated Shelikof Strait as a special aquatic foraging area for the Stellar Sea Lion. See 58 Federal Register (FR) 45278 (September 27, 1993); see also 50 CFR 226.12(c)(1). Therefore, the proposed NPDES general permit prohibits discharges in Shelikof Strait.

The existing NPDES general permit prohibits discharges within 1,000 meters of a coastal marsh, river delta, or river mouth, or an AMSA, SGR, or CHA. In the proposed NPDES general permit, EPA proposes to expand this prohibition to a distance of 4,000 meters to afford better protection of these sensitive areas. EPA knows of no plans for oil and gas facilities to operate in those areas, so the change should not have an impact on any of these facilities. With modern drilling technologies, there should be no need to operate within the expanded buffer zone. The following SGRs, SGSs, CHAs, AMSAs, and National Park are in the proposed NPDES general permit coverage area:

Anchorage Coastal Wildlife Refuge
Clam Gulch CHA
Goose Bay SGR
Kachemak Bay CHA
Kalgin Island CHA
Lake Clark National Park
McNeil River SGS
Palmer Bay Flats SGR
Port Graham/Nanwalek AMSA
Potter Point SGR
Redoubt Bay CHA
Susitna Flats SGR
Trading Bay SGR

Alaska Statute (AS) section 16.20 contains the legal descriptions of these state specialty areas. The present boundaries of these state special areas are described in a document titled the *State of Alaska Refuges, Critical Habitat Areas, and Sanctuaries*, prepared by the Alaska Department of Fish and Game, Habitat Division, dated March 1991. Further information may also be obtained from the Alaska Department of Natural Resources, Office of Habitat Management and Permitting, 550 West 7th Avenue, Suite 1420, Anchorage, Alaska, 99501; phone (907) 269-8690.

1.2.3 Regulatory Status Classification of Waters within Area of Coverage

The proposed NPDES general permit includes a classification of the regulatory status of waters within the area of coverage as one of the following categories:

- ***Coastal Waters***: the portion of Cook Inlet north of the southern edge of Kalgin Island (Northern Cook Inlet). Coastal waters are not subject to the ODCE analysis.

- ***Offshore Waters***: the area of Cook Inlet south of the coastal waters (Southern Cook Inlet)
    - ***Territorial Seas***: the first 3 miles of the Offshore Waters of Southern Cook Inlet measured from the coastline or the boundary between coastal and offshore waters
    - ***Federal Waters***: the portion of the Offshore Waters of Southern Cook Inlet seaward of the territorial seas, which is defined as the contiguous zone, which is the adjacent portion of the ocean

Specific limitations and monitoring requirements for each of these categories are set forth in the proposed NPDES general permit and will be discussed in the following sections as appropriate.

1.2.4 Classification of Discharges

The proposed NPDES general permit includes a classification of discharges from platform-based oil and gas operations. Discharges can be from one of the following categories:

- ***Exploratory Operations*** are conducted to determine the nature of potential hydrocarbon reserves. Drilling is the main activity during exploratory operations. Wastewater discharges from exploratory operations typically include drilling fluids; drill cuttings and washwater; deck drainage; sanitary wastes; domestic wastes; desalination unit wastes; blowout preventer fluid; boiler blowdown; fire control system test water; noncontact cooling water; uncontaminated ballast water; uncontaminated bilge water; excess cement slurry; mud, cuttings, and cement at the seafloor; and well completion fluids. In general, exploratory facilities do not discharge waterflood wastewater, produced water, or well treatment fluids.

- ***Development Operations*** consist of drilling and completion of producing wells, which can be conducted from fixed or mobile facilities. Discharges associated with development operations include all those listed above for exploratory operations. In addition, generally, facilities engaged in development operations discharge produced water and well treatment fluids.

- ***Production Operations*** consist of the active recovery of hydrocarbons from producing formations after development has been completed. Facilities conducting production operations are likely to discharge produced water, well treatment fluids, workover fluids, deck drainage, sanitary wastes, domestic wastes, desalination unit wastes, blowout preventer fluid, boiler blowdown, fire control system test water, noncontact cooling water, uncontaminated ballast water, and uncontaminated bilge water. Some production operations also discharge waterflood wastewater, which is used to enhance production from older fields. In general, facilities engaged slowly in production do not discharge drilling fluids, drill cuttings, well completion fluids, or mud, cuttings, and cement at the seafloor, except when wells are worked over.

    - Some existing production platforms are equipped to separate oil and gas from produced water; these platforms then discharge produced water directly to Cook Inlet.

    - Other production platforms, however, perform only initial oil/water separation, and route their produced water to *onshore facilities* for further treatment; in these cases, produced water is discharged from the onshore facility.

Specific limitations and monitoring requirements for each of these categories are set forth in the proposed NPDES general permit and will be discussed in the following sections as appropriate.

1.3 Overview of Report

This evaluation focuses on sources, fate, and potential effects of discharges of exploratory, development, and production activities from platform-based oil and gas operations on various groups of aquatic life. The types and projected quantities of discharges are detailed in Section 2.0. Anticipated amounts or volumes of wastes, approximate chemical composition, and concentrations are also given. The fate, transport, and persistence of the wastes is examined in Section 3.0, which covers dilution, dispersion, and persistence of discharged constituents in relation to influential receiving water properties, including water depth, ice coverage, currents, wind, and waves. Before discussing potential biological or ecological effects, an overview of aquatic communities and important species is presented in Section 4.0. The means by which platform-based oil and gas operation discharges could impact marine life and concentrations at which effects have been documented are presented in Section 5.0. Section 6.0 summarizes the *biological evaluation* of endangered and threatened species required by the Endangered Species Act (ESA). Especially important uses and plans for the proposed NPDES general permit area, including commercial, recreational and subsistence harvests, special aquatic sites, and coastal zone management plans, are discussed in Sections 7.0 and 8.0. Section 9.0 discusses the compliance of expected discharges with federal and state water quality criteria. Section 10.0 summarizes the findings of this report and Section 11.0

2.0 COMPOSITION AND QUANTITIES FOR MATERIALS DISCHARGED

Oil and gas exploration, development, and production facility operations can produce a wide range of waste materials related to the drilling and extraction processes, maintenance of equipment, and personnel housing. The proposed NPDES general permit for Cook Inlet authorizes discharges from the following waste streams:

- Drilling Fluids and Drill Cuttings
- Deck Drainage
- Sanitary Wastes
- Domestic Wastes
- Desalination Unit Wastes
- Blowout Preventer Fluid
- Boiler Blowdown
- Fire Control System Test Water
- Non-Contact Cooling Water
- Uncontaminated Ballast Water
- Bilge Water
- Excess Cement Slurry
- Mud, Cuttings, Cement at Seafloor
- Completion Fluids
- Workover Fluids
- Test Fluids
- Storm Water Runoff from Onshore Facilities

Waterflooding discharges, produced water discharges, and well treatment fluids (other than test fluids) would also be authorized for existing upper Cook Inlet development and production operations. In the discussions below, discharges from existing Cook Inlet facilites are presented as an example of the volumes currently being discharged. Since these operations occur in coastal waters, they are not subject to this ODCE analysis and details are presented only as an example.

2.1 DRILLING FLUIDS AND DRILL CUTTINGS

Drilling fluids (also known as drilling muds or muds) are suspensions of solids and dissolved materials in a water or oil base that are used in rotary drilling operations. The rotary drill bit is rotated by a hollow drill stem made of pipe, through which the drilling fluid is circulated. Drilling fluids are formulated for each well to meet specific physical and chemical requirements. Geographic location, well depth, rock type, geologic formation, and other conditions affect the fluid composition required. The number and nature of fluid components varies by well, and several products may be used at any time to create the necessary properties (Avanti 1991). The basic functions of a drilling fluid include

- Transport drill cuttings to the surface
- Suspend drill cuttings in the annulus when circulation is stopped
- Control subsurface pressure
- Cool and lubricate the bit and drill string
- Support the walls of the wellbore
- Help suspend the weight of the drill string and casing
- Deliver hydraulic energy upon the formation beneath the bit
- Provide a suitable medium for running wireline logs (USEPA 1985a)

Five basic components for approximately 90 percent by weight of the materials that compose drilling fluids are barite, clay, lignosulfonate, lignite, and caustic soda (Avanti 1991). Stock barite, which is added to drilling fluids, contains cadmium and mercury. Barite is the main source of heavy metals in drilling fluid discharges.

Drilling fluids can be water-based or oil-based. In water-based fluids, water is the suspending medium for solids and is the continuous phase, whether or not oil is present. Water-based drilling fluids are composed of approximately 50 to 90 percent water by volume, with additives comprising the rest. Water-based fluids may contain diesel oil in greater than trace amounts. The diesel oil up to 4 percent, is added to reduce torque and drag. In a stuck pipe situation, a *pill* (diesel oil or oil-based drill fluid) is pumped down the drill string and "spotted" in the annulus area. The pill may or may not be separated out of the bulk fluid system. If the pill is removed, a small amount of diesel remains with the fluid system (Avanti 1991).

Nonaqueous drilling fluid is drilling fluid that has water-immiscible fluid as its continuous phase and as the suspending medium for solids. Types of these fluids include oil-based fluid, enhanced mineral oil-based fluid, and synthetic-based fluid (Avanti 1991). Oil- and mineral oil-based fluids are well suited for high temperature conditions found in deep wells because oil has a higher boiling point than water and pore-clogging problems that sometimes occur with use of water-based fluids can be avoided. Oil-based fluids are generally more costly and are more toxic to marine organisms than water-based fluids. EPA estimated that about 15 percent of wells drilled deeper than 3,000 meters (approximately 10,000 feet) used some oil-based fluids (USEPA 1993b). Because the industry trend is toward deeper wells, oil-based fluids might become more prominent. However, oil-based fluid cuttings cannot be discharged, so increased use of oil-based fluids might not occur. The oil and gas industry has developed several new oleaginous (oil-like) base materials since about 1990 for use in high performance synthetic-based drilling fluids. Some synthetic materials used in these fluids are vegetable esters, poly alpha olefins, internal olefins, linear alpha olefins, synthetic paraffins, ethers, and linear alkylbenzenes. These synthetic-based fluids were developed to provide the performance characteristics of traditional oil-based fluids and to have the potential for lower environmental impact and greater worker safety through lower toxicity, elimination of polynuclear aromatic hydrocarbons (PAHs), faster biodegradability, lower bioaccumulation potential, and in some cases, decreased drilling waste volume (61 FR 66086, December 16, 1996) (USEPA 2000).

Drill cuttings are the waste rock particles that are brought up from the well bore during exploratory drilling operations. During typical operations, a mixture of cuttings and drilling fluids returns to the surface between the drill pipe and the bore hole. At the surface, the cuttings and fluid are separated, and the cuttings are either saved for analysis or disposed of by discharge into adjacent waters. The main source of pollutants in drill cuttings are associated with the drilling fluids that adhere to the rock particles (USEPA 2000).

The discharge of drilling fluids is authorized only at exploratory facilities and at existing production and development facilities. The discharge of nonaqueous-based drilling fluids is prohibited at all facilities except for situations where such fluids adhere to drill cuttings at facilities in the territorial seas (the first 3 miles measured from the coastline or boundary between coastal and offshore waters) and federal waters (contiguous zone or ocean). After use. synthetic-based fluids are brought to shore and refurbished so they can be reused. Also, using synthetic-based fluids during drilling allows operators to drill slimmer wells and cause less erosion of the well during drilling than drilling using water-based fluids. Therefore, the volume of drill cuttings discharged is reduced when using synthetic-based fluids in comparison to using water-based fluids (USEPA 2000).

Federal guidelines for the discharge of drilling fluids and cuttings in offshore and coastal waters establish limits that are required throughout Cook Inlet (USEPA 1996). On the basis of those guidelines, the limits and prohibitions for the proposed NPDES general permit include:

- No discharge of free oil
- No discharge of diesel oil
- A minimum toxicity limit of 3 percent by volume
- Cadmium and mercury in stock barite, which is added to drilling fluids, are limited to 3 mg/kg and 1 mg/kg, respectively
- No discharge of nonaqueous-based drilling fluids in Territorial Seas and federal waters, except those that adhere to drill cuttings
- The toxicity of suspended particulate phase of drilling fluids is limited to 30,000 parts per million (ppm)

Free oil in drilling fluids discharges is to be measured using the static sheen test method. Toxicity is measured with a 96-hour LC_{50} on the suspended particulate phase using the *Leptachoirus plumniosus* species. Cadmium and mercury are measured using USEPA Methods 245.5 or 7471 on the stock barite prior to adding it to drilling fluids. These best available pollution control technology economically achievable (BAT) and new source

Federal guidelines for NSPS, BAT, and best conventional pollution control technologies (BCT) for the offshore and coastal subcategories of the oil and gas extraction point source category require no discharge of free oil (EPA 2006). The deck drainage discharged from the oil and gas platforms in the Cook Inlet NPDES general permit area of coverage is expected to meet the effluent limitations requirements listed in Table 2 of the proposed NPDES general permit and the appropriate Alaska Water Quality Standards in 18 AAC 70.

Deck drainage discharges are not continuous and vary significantly in volume. At the times of platform washdowns, the discharges are of relatively low volume and are anticipated. During rainfall events, very large volumes of deck drainage may be discharged in a very short period of time. Volumes of deck drainage discharged from platforms in Cook Inlet range from 109 to 6,300 gpd with a discharge route of ocean discharge. One platform (Monopod Platform) discharges 15,000 gpd of deck drainage to the Trading Bay Treatment Facility for treatment. The average flow of deck drainage for the Osprey Platform is 108,000 gpd (NCG 2001), depending on precipitation (SAIC 2001).

2.3 SANITARY WASTES

Sanitary waste is human body waste discharged from toilets and urinals. The pollutants associated with this discharge include suspended solids, 5-day biochemical oxygen demand (BOD_5), fecal coliform, and residual chlorine (SAIC 2001). The volume of domestic waste discharged has been estimated to range from 50 to 100 gallons per person per day (USEPA 1993a). Discharge of domestic waste from an Alaskan offshore oil rig is usually less than 6,000 gallons per day according to discharge monitoring reports (Tetra Tech 2006). Volumes of treated sanitary waste discharged from platforms in Cook Inlet range from 1,500 gpd to 2,740,000 gpd (Tetra Tech 2006).

The offshore and coastal subcategory ELGs for NSPS and BCT require residual chlorine to be maintained as close to 1 mg/L as possible for facilities continuously manned by 10 or more persons. The ELGs also require no discharge of floating solids for offshore facilities continuously manned by nine or fewer persons or intermittently manned by any number of persons.

The expired general permit specified a maximum Total Residual Chlorine limit of 19 mg/L and a minimum requirement of 1 mg/L. The proposed general permit will specify a maximum Total Residual Chlorine limit of 2 mg/L and maintain the existing minimum requirement of 1 mg/L for facilities located in territorial seas. The proposed general permit will specify a maximum Total Residual Chlorine limit of 13.5 mg/l and a minimum of 1mg/l only for facilities in coastal waters.

The expired general permit also included water quality based limits for biochemical oxygen demand (BOD), and total suspended solids (TSS). The proposed general permit would maintain the existing effluent limitations for these parameters in coastal waters and Territorial Seas.

The sanitary waste discharged from the oil and gas platforms in the Cook Inlet NPDES general permit area of coverage is expected to meet the effluent limitations requirements established in the proposed NPDES general permit and the appropriate Alaska Water Quality Standards in 18 AAC 70. In cases where sanitary and domestic wastes are mixed prior to discharge, the discharge limitations for domestic wastes also apply to the mixed waste stream. Common routes for these discharges are ocean discharge and underground injection.

2.4 DOMESTIC WASTES

Domestic waste (gray water) refers to materials discharged from sinks, showers, laundries, safety showers, eyewash stations, and galleys. Gray water can include kitchen solids, detergents, cleansers, oil and grease (SAIC 2001). Volumes of domestic waste discharged from platforms in Cook Inlet range from 200 to 1,300,000 gpd (Tetra Tech 2006).

Federal guidelines for NPSP, BAT, and BCT for the offshore and coastal subcategories of oil and gas extraction point sources require no discharge of floating solids or foam. This limit is contained in the existing NPDES general permit and will be included without modification in the proposed NPDES general permit.

The domestic waste discharged from the oil and gas platforms in the Cook Inlet proposed NPDES general permit area of coverage is expected to meet the effluent limitations requirements listed in Table 4 of the proposed NPDES general permit and the appropriate Alaska Water Quality Standards in 18 AAC 70. In cases where sanitary and domestic wastes are mixed prior to discharge, the discharge limitations for sanitary wastes also apply to the mixed waste stream. Common routes for these discharges are ocean discharge and underground injection.

2.5 MISCELLANEOUS DISCHARGES

The miscellaneous discharges (desalination unit wastes; blowout preventer fluid; boiler blowdown; fire control system test water; noncontact cooling water; uncontaminated ballast water; bilge water; excess cement slurry; mud, cuttings, cement at the seafloor; and waterflooding) from the oil and gas platforms in the Cook Inlet proposed NPDES general permit area of coverage are expected to meet the effluent limitations requirements listed in Table 5 of the proposed NPDES general permit and the appropriate Alaska Water Quality Standards in 18 AAC 70.

The proposed NPDES general permit contains a visual sheen monitoring requirement for miscellaneous discharges that has been modified slightly from the existing NPDES general permit. The requirements of treating uncontaminated ballast water and bilge water with an oil-water separator before discharge and no free oil discharges in the existing NPDES general permit have been carried forward in the proposed NPDES general permit.

2.5.1 Desalination Unit Wastes

Desalination wastewater is the residual high-concentration brine discharged from distillation or reverse osmosis units used for producing potable water and high-quality process water offshore. It has a chemical composition and ratio of major ions similar to sea water, but with high concentrations (Avanti 1991). Additives discharged with desalination wastes include cleanser, water purifier, and acidifier/scale remover (Tetra Tech 2006). Volumes of desalination unit wastes discharged from platforms in Cook Inlet range from 55 to 110,000 gpd (Tetra Tech 2006). Common routes for these discharges are ocean or surface water discharge and underground injection.

2.5.2 Blowout Preventer Fluid

A vegetable or mineral oil solution or antifreeze (polyaliphatic glycol) is used as a hydraulic fluid in blowout preventer stacks while drilling a well. The blowout preventer may be located on the seafloor and is designed to contain pressures in the well that cannot be maintained by the drilling fluid. Small quantities of blowout preventer fluid are discharged periodically to the seafloor during testing of the blowout preventer device (Avanti 1991). The volume of blowout preventer fluid discharge (Tetra Tech 2006) has been estimated to range from 67 to 314 bbl per day (USEPA 1993a). Discharge volumes of 100 gpd have been reported for some platforms in Cook Inlet (Tetra Tech 2006). A common route for this discharge is ocean discharge.

2.5.3 Boiler Blowdown

Boiler blowdown is the discharge of water and minerals drained from boiler drums to minimize solids buildup in the boiler (SAIC 2001). Volumes of boiler blowdown discharged from platforms in Cook Inlet range from 42 to 100 gpd (Tetra Tech 2006). Common routes for these discharges are ocean or surface water discharge.

2.5.4 Fire Control System Test Water

Fire control system test water is sea water that is released during the training of personnel in fire protection and the testing and maintenance of fire protection equipment on the platform (SAIC 2001). Test water may be treated with a biocide. This discharge is intermittent (Tetra Tech 2006). Volumes of fire control system test water discharged from platforms in Cook Inlet range from 100 to 30,000 gpd (Tetra Tech 2006). To meet effluent limitations for these discharges, several facilities listed in this table treat contaminated fire control system test water with an oil-water separator prior to discharge to ocean or surface water.

2.5.5 Noncontact Cooling Water

Noncontact cooling water is sea water that is used for noncontact, once-through cooling of various pieces of machinery on a platform (SAIC 2001). Noncontact cooling water is not significantly different in composition than ambient sea water, except for an elevated temperature (estimated at 62° to 84°F) (USEPA 1996). Discharge of noncontact cooling water from an Alaskan offshore oil rig is approximately 210,000 gpd according to discharge monitoring reports (Tetra Tech 2006). Volumes of noncontact cooling water discharge categories. These limits for produced water are contained in the existing NPDES general permit and are included without modification in the proposed NPDES general permit.

Completion, workover, well treatment, and test fluids from the oil and gas platforms in the Cook Inlet NPDES general permit area of coverage are expected to meet the effluent limitations requirements listed in Table 8 of the proposed NPDES general permit and the appropriate Alaska Water Quality Standards in 18 AAC 70. Routes for these discharges are ocean discharge and underground injection.

2.7.1 Completion Fluids

Completion fluids are salt solutions, weighted brines, polymers, and various additives used to prevent damage to the well bore during operations that prepare the drilled well for hydrocarbon production. These fluids move into the formation and return to the surface as a slug with the produced water. Completion fluids are used to plug the face of the producing formation while drilling or completion operations are conducted in hydrocarbon-bearing formations. They prevent fluids and solids from passing into the producing formation, thereby preventing reduced productivity of the formation or damaging the oil or gas. The composition of the completion fluid is site-specific depending on the nature of the producing formation (Avanti 1991).

2.7.2 Workover Fluids

Workover fluids are salt solutions, weighted brines, polymers, and other specialty additives used in a producing well to allow safe repair and maintenance or abandonment procedures. Packer fluids, low solids fluids between the packer, production string, and well casing are considered to be workover fluids (Avanti 2001).

2.7.3 Well Treatment Fluids

Well treatment fluids are used to restore or improve productivity by chemically or physically altering hydrocarbon-bearing strata after a well has been drilled (40 CFR Part 435.11). These fluids are similar to drilling fluid and may contain a range of chemicals and naturally occurring materials (e.g., trace metals) (USEPA 2000).

2.7.4 Test Fluids

Test fluids are the discharge that would occur should hydrocarbons be found during exploratory drilling and are tested for formation pressure and content. It consists of drilling fluids sent downhole during testing along with water from the formation as described in the proposed NPDES general permit. Test fluid discharge may consist of formation water, vegetable or mineral oil, natural gas, formation sands, any added acids or chemicals, or any combination thereof (USEPA 1985b). Test fluids are generally stored and treated with acid to remove oil before being discharged. The addition of strong acidic solutions downhole could cause substantial leaching of heavy metals from the formation and residual drilling fluid (EPA 2000).

2.8 CHEMICALLY TREATED SEA WATER DISCHARGES

More than 20 biocides are used to treat sea water and fresh water in offshore oil and gas operations. These chemicals include aldehydes, formaldehyde compounds, amine salts, and other compounds. The toxicity of these compounds to marine organisms (as measured with a 96-hour LC_{50} test) can range from 0.4 mg/L to > 1,000 mg/L. Compounds commonly used in scale inhibitors are amine phosphate ester and phosphonate compounds. Scale inhibitors are generally less toxic to marine life than biocides with 96-hour LC_{50} values ranging from 1,676 to > 10,000 mg/L. Corrosion inhibitors are generally more toxic to marine life than scale inhibitors with 96-hour LC_{50} values ranging from 1.98 to 1,050 mg/L (Tetra Tech 2006).

The discharge of specific biocides, scale inhibitors, and corrosion inhibitors is currently not covered in the proposed NPDES general permit for several reasons, including the following:

- Because of the large number of chemical additives used, it would be very difficult to develop technology-based limits for each additive.

- If the permit did limit specific chemicals, it could potentially impede the development and use of new and potentially more beneficial treatment chemicals that would not be specifically listed in the permit and for which discharge would not be authorized.

- Field conditions for each producing well can change and require different treatment during the period of permit coverage.

Concentrations of treatment chemicals in discharges of sea water or fresh water will be limited to the most stringent of the following EPA requirements:

- The maximum concentrations and any other conditions specified in the EPA product registration labeling if the chemical additive is an EPA-registered product

- The maximum manufacturer's recommended concentration when one exists

- A maximum of 500 mg/L

The Proposed Permit contains BCT limits prohibiting the discharge of free oil for chemically-treated seawater and freshwater discharges

2.9 STORMWATER RUNOFF FROM ONSHORE FACILITIES

Activities that take place at onshore facilities, such as material handling and storage, equipment maintenance and cleaning, or other operational activities are often exposed to stormwater. The runoff from these activities may discharge pollutants into nearby waterbodies, degrading water quality. Operators of onshore facilities are required under the proposed NPDES general permit to develop and implement stormwater pollution prevention plans (SWPPPs). The SWPPPs must include best management practices (BMPs) to monitor and maintain operations to prevent contamination of stormwater.

2.10 DISCHARGES FROM COOK INLET OIL AND GAS PRODUCTION FACILITIES

Table 2 shows the discharges from oil and gas production facilities in Cook Inlet, as presented in the *Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 Final Environmental Impact Statement* (MMS 2003). Table 3 shows the estimates of exploration well drilling discharges, additives, and usage rates in Alaska OCS waters.

2.11 SUMMARY

According to estimates provided in the *Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 Final Environmental Impact Statement* (MMS 2003), an average of 11 wells are drilled per year in Cook Inlet (see Table 5 in Section 5.3 of this ODCE), which generate a total of approximately 3,690 tons of drilling fluids and 5,590 tons of drill cuttings for disposal. This would result in the discharge of approximately 930 tons of suspended sediments. Discharges from exploration, development, and production activities are expected to meet the appropriate effluent limitations requirements listed in the proposed NPDES general permit and the appropriate Alaska Water Quality Standards in 18 AAC 70.

Discharges to Cook Inlet from development and production facilities will include deck drainage; sanitary wastes; domestic wastes; sanitary wastes; domestic wastes; desalination unit wastes; blowout preventer fluid; boiler blowdown; fire control system test water; noncontact cooling water; uncontaminated ballast water; bilge water; excess cement slurry; cement at seafloor; waterflooding discharges; completion fluids; workover fluids; well treatment fluids; and test fluids. In addition, discharges from exploration facilities will include drilling fluids and drill cuttings.

The discharge of drilling fluids and drill cuttings is authorized only at exploratory facilities and existing facilities. Also, the discharge of nonaqueous based drilling fluids is prohibited except for situations where such fluids adhere to drill cuttings at facilities located in the territorial seas and federal waters. Operators are limited to drilling discharges from no more than five wells at a single drilling site as described in the proposed NPDES general permit.

The discharge of produced water is not authorized from new sources and new exploratory facilities under the proposed NPDES general permit.

Deck drainage contaminated with oil and grease and all bilge water must be processed through an oil-water separator prior to discharge. Discharge of sanitary wastes will result in the discharge of suspended solids, BOD_5, fecal coliform, and residual chlorine; however, concentrations are expected to be in accordance with appropriate water quality standards for the state of Alaska and effluent limitations provided in the proposed NPDES general permit. The other discharges (domestic waste; desalination unit waste; blowout preventer fluid; mud, cuttings, and cement at seafloor; completion, workover,

3.0 TRANSPORT, PERSISTENCE, AND FATE OF MATERIALS DISCHARGED

3.1 TRANSPORT AND PERSISTENCE

Factors influencing the transport and persistence of discharged pollutants include oceanographic characteristics of the receiving water, meteorologic conditions, characteristics of the discharge, discharge rate, and method of disposal.

The quality of the Cook Inlet aquatic environment is determined by water's physical and chemical characteristics. Naturally occurring and contaminant substances enter Cook Inlet waters and are diluted and dispersed by the currents associated with the tides, estuarine circulation, wind-driven waves and currents, and Coriolis force. Based on standard salt balance calculations, 90 percent of waterborne contaminants would be flushed from the inlet in 10 months (Kinney et al. 1969, 1970). Because tidal turbulence is the major mixing factor in Cook Inlet rather than seasonally varying fresh water input, this flushing rate is relatively seasonally invariant. However, some of the persistent contaminants may accumulate in (1) the food chain and exceed toxic thresholds, particularly in predators near the top of the food chain, or (2) the seafloor sediments (MMS 2003).

Within a distance of between 100 and 200 meters from the discharge point, the turbidity caused by suspended particulate matter in the discharged fluids and cuttings is expected to be diluted to levels that are within the range associated with the variability of naturally occurring suspended-particulate matter concentrations (MMS 2003). Brandsma (1999) determined that the high suspended solids discharge of drilling fluids in Cook Inlet would be reduced more than two orders of magnitude within 100 meters under the least turbulent conditions and three orders of magnitude under more turbulent conditions (SAIC 2001). In general, the amounts of additives in the other discharges are expected to be relatively small (from 4 to 400 or 800 liters per month) and diluted with sea water several hundred to several thousand times before being discharged into the receiving waters (MMS 2003).

The nonvolatile hydrocarbons (oil and grease) in the produced waters from an existing oil production platform would be diluted a thousand times within several hundred meters if discharged. At a 1,000:1 dilution, the concentrations of nonvolatile hydrocarbons would reduce from 29 parts per million to 29 parts per billion (a concentration less than several of the facility-specific incremental water quality-based limits presented in the proposed NPDES general permit) within several hundred meters of the platform. The concentrations of total aromatic hydrocarbons might range from 8 to 13 parts per million close to the platform and 8–13 parts per billion, which is also less than several of the facility-specific incremental water quality-based limits presented in the proposed NPDES general permit. At some point within this several-hundred-meter distance, acute and chronic criteria would be exceeded. In territorial seas and federal waters, mixing zones are limited to a 100-meter radius (MMS 2003). This limitation does not apply to state waters, where mixing zones might be expanded using platform discharge rates and pollutant concentrations reported by the operators. Proposed and previous mixing zone lengths for produced water discharges are provided in the proposed NPDES general permit fact sheet. State water quality standards do require that acute aquatic life criteria are met at a boundary of a smaller zone of initial dilution, established within the mixing zone (18 AAC 70.255). Some existing operators wishing to discharge produced waters in Cook Inlet would have difficulty in meeting federal water quality criteria at the edge of the mixing zone: reinjection of produced waters is a more viable option for those operators (MMS 2003).

Detailed oceanographic data on the environment of Cook Inlet are provided in the *Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 Final Environmental Impact Statement* (MMS 2003). Oceanographic and meteorologic conditions in Cook Inlet are briefly described in the following sections. Characteristics of the discharge, including composition and discharge rate, were described in Section 2. Aqueous-based drilling fluids and drill cuttings and nonaqueous-based drilling fluids that adhere to drill cuttings will be discharged below the surface; no discharge will occur in water depths less than 5 meters. Discharges of produced water from new sources and new exploratory facilities are not authorized under the proposed NPDES general permit.

3.1.1 Oceanography

Cook Inlet is a tidal estuary approximately 290 kilometers (180 miles) long and 97 kilometers (60 miles) wide at its mouth, with a general northeast-southwest orientation. It is divided naturally into the upper and lower inlet by the East and West Forelands, where the inlet is approximately 16 kilometers (10 miles) wide (SAIC 2001).

The upper Cook Inlet is typically about 27 to 30 kilometers (17 to 19 miles) wide and has relatively shallow water depths. Water depths are close to 30 to 61 meters (100-200 feet) (below MLLW) but can exceed 152 meters (500 feet) in deeper channels closer to the Forelands (SAIC 2001).

Tides in Cook Inlet are classified as mixed, having strong diurnal and semi-diurnal components, and are characterized by two unequal high and low tides occurring over a period of approximately one day, with the mean range increasing northward (MMS 1995). Currents in the upper Cook Inlet are predominantly tidally driven. Current speeds are primarily a function of the tidal range, and their directions typically parallel the bathymetric contours. Near the mouths of major rivers, such as the Susitna River, currents may locally influence both the current speed and direction by the large volume of fresh water inflow (SAIC 2001).

The lower portion of Cook Inlet is influenced by the Alaskan Stream and by a parallel current in the western Gulf of Alaska called the Kenai Current or the Alaska Coastal Current (MMS 2003). The Alaska Coastal Current flows along the inner shelf in the western Gulf of Alaska and enters Cook Inlet and Shelikof Strait (Shumacher and Reed 1980; Royer 1981a, 1981b). The current is narrow (less than 30 kilometers) and high-speed (20–175 centimeters per second) with flow that is driven by fresh water discharge and inner-shelf winds (MMS 2003). Peak velocities of 175 centimeters/second occur in

September through October (Johnson et al. 1988). The Alaska Coastal Current transport volume ranges from 0.1-1.2 million cubic meters per second and varies seasonally in response to fresh water runoff fluctuations, regional winds, and atmospheric pressure gradients (Luick et al. 1987; Royer 1981a, 1981b, 1982; Reed et al. 1987; Schumacher and Reed 1980, 1986; Schumacher et al. 1989). Oxygen isotope measurements in late summer show that glacial meltwater may provide much of the total fresh water runoff into the Alaska Coastal Current (Kipphut 1990).

Strong tidal currents also produce pronounced and persistent tidal rips at various locations in the inlet. It is believed that these features occur primarily at locations of relatively abrupt bathymetric changes. Tidal rips can be marked by surface debris and steep waves. They can also be hazardous to small boat traffic, however, tidal rips would not typically be a significant problem for platform, pipeline, or rig boat operations. It also has been hypothesized that the tidal rips are important habitat to marine species (SAIC 2001).

A general circulation pattern is also present throughout the inlet. Limited circulation information for the upper inlet suggests that there may be a net southwesterly flow along the western side of the inlet, primarily as a result of fresh water inflows near the head of the inlet (Susitna River and from the Knik and Turnagain Arms). Below the Forelands, oceanic waters most commonly flow up the eastern side and turbid and fresher waters flow southward along the western side (SAIC 2001).

Waves in upper and central Cook Inlet are fetch and depth limited, and wave heights are usually less than 3 meters (10 feet). In storms, waves in the upper inlet (Beluga area) can reach 4.5 meters (15 feet) (USCOE 1993) with wave periods estimated up to 6 to 8 seconds (SAIC 2001).

Ice is present in Cook Inlet for up to 5 months each year, but can vary greatly from year to year. On average, ice will be present in the inlet from late November through early April. Three forms of ice normally occur in the inlet: sea ice, beach ice, and river ice. Sea ice is the predominant type and is formed by freezing of the inlet water from the surface downward. Because of the strong tidal currents, ice does not occur as a continuous sheet but as ice pans. Pans can form up to 1 meter (3 feet) thick and be 305 meters (1,000 feet) or greater across (SAIC 2001). They can also form pressure ridges reportedly up to 5.5 meters (18 feet) high (Gatto 1976). Sea ice generally forms in October or November, gradually increasing from October to February from the West Foreland to Cape Douglas, and melts in March to April (Brower el al. 1988). The primary factor for sea ice formation in upper Cook Inlet is air temperature, and for lower Cook Inlet it is the Alaska Coastal Current temperature and inflow rate (Poole and Hufford 1982).

Beach ice, or stamukhi, forms on tidal flats as sea water contacts cold tidal muds. The thickness of beach ice is limited only by the range of the tides and has been noted to reach 9 meters (30 feet) in thickness. During cold periods, beach ice normally remains on the beach; however, during warm weather in combination with high tides, it can melt free and enter the inlet. Blocks of beach ice that enter the inlet are normally relatively small (less than several tens of feet across) and have relatively low strengths (SAIC 2001).

River ice can also occur in Cook Inlet. It is a fresh water ice that is similar to sea ice except that it is relatively harder. It is often discharged into the inlet during spring breakup (SAIC 2001).

3.1.2 Meteorology

The climate of the central Cook Inlet area is characterized as transitional between maritime and continental regimes. Regional topography and waterbodies heavily influence area climate. The Kenai Mountains to the south and east act as a barrier to warm, moist air from the Gulf of Alaska. The Alaska Range to the north provides a barrier to the cold winter air masses that dominate the Alaska Interior. Cook Inlet waters tend to moderate temperatures in the area. Occasionally, short periods of extreme cold and/or high winds occur when strong pressure gradients force cold air southward from the interior (SAIC 2001).

In the lower Cook Inlet region, the climate is transitional from a maritime to a continental climate. Generally, lower Cook Inlet is a maritime climate, wetter and warmer than the upper Cook Inlet region, which exhibits some continental climatic features—that is, the upper Cook Inlet region is drier and cooler than the lower (MMS 2003).

Overland and Heister (1980) define six Gulf of Alaska weather types that influence the lower Cook Inlet. The Aleutian low-pressure center occurs most often. The Aleutian Low, a semipermanent low-pressure system over the Pacific Ocean, has a strong effect on the climate in the area. As this low-pressure area moves and changes in intensity, it brings storms with wind, rain, and snow (Wilson and Overland 1986). The other weather types are the low-pressure center over central Alaska; the stagnating low off of Queen Charlotte Islands; and the Pacific Anticyclone, also known as the East Pacific High (Overland and Hiester 1980). Generally, winter is characterized by an inland high-pressure cell with frequent storm progressions from the west along the Aleutian chain. During summer, a low-pressure cell is over the inland area, with fewer storms (MMS 2003). Spring and fall are characterized by a transition between these generalized patterns (Macklin 1979).

Precipitation decreases from south to north along the inlet. Kodiak is the wettest, and Anchorage is drier (MMS 2003). Cook Inlet precipitation (SAIC 2001) averages less than 20 percent of that measured on the Gulf of Alaska side of the Kenai Mountains (NCG 2001). Homer, Kenai, and Anchorage all have substantially less precipitation than Kodiak due to the sheltering or *rain shadow* effect of the Kenai Mountains. Homer averages about 65 centimeters of precipitation annually, and Anchorage averages about 40 centimeters. The wettest months are September and October, with the relatively dry conditions in April through July. In the northern inlet, precipitation usually falls as snow from October to April and as rain the rest of the months. Farther south in the inlet, a greater percentage of the precipitation falls as rain (MMS 2003).

Winds in the area are strongly influence by mountains surrounding the Cook Inlet Basin. During the months of September through April, prevailing winds are typically from the north or northwest. During May through August, winds prevail from the south. Mean speeds range from 5 knots in December to 7 knots in May (Brower et al. 1988). Site-specific, short-term data confirm the general trends described above. For example, winds measured at the West Foreland in 1999 and 2000 indicate that during September through April, prevailing winds are from the north-northeast and northeast. During June and July, winds prevail from the south-southwest and southwest. May and September are transition periods for these patterns (HCG 2000a, 2000b, 2000c, 2000d). Extreme winds are commonly out of the northeast or south (SAIC 2001).

3.2 SUMMARY

Overall, Cook Inlet is a high-energy environment. Fast tidal currents and tremendous mixing produce rapid dispersion of soluble and particulate pollutants. If facility operators comply with proposed NPDES general permit requirements, it is expected that discharges from oil and gas exploration, development, and production facilities would not have a measurable effect on the overall quality of Cook Inlet water.

4.0 Composition of Biological Communities

4.1 Plankton

Planktonic communities typically consist of both phytoplankton and zooplankton. During summer months, lower Cook Inlet is among the most productive high-latitude shelf areas in the world (MMS 1996). However, marine productivity in northern Cook Inlet is limited by severe turbidity and extreme tidal variations. The silt-laden waters that enter Upper Cook Inlet load the inlet with sediment and retard its primary (phytoplankton) productivity (Kinney et al. 1970). Larrance et al. (1977) found that lower Cook Inlet marine productivity decreased in a northerly direction. At a station immediately south of the Forelands, the euphotic zone (the upper limit of effective light penetration for photosynthesis) was extremely shallow, ranging from 1 to 3 meters (3 to 10 feet) (SAIC 2002). The suspended material limits light penetration and probably causes reduced surface nitrate utilization in the spring (Sambrotto and Lorenzen 1987).

Zooplankton are used as food for fish, shellfish, marine birds, and some marine mammals. Zooplankton feed on phytoplankton, and their growth cycles respond to phytoplankton production. In the lower inlet, zooplankton populations vary seasonally with biomass reaching a low in the early spring and a peak in late spring and summer. Zooplankton is abundant in the lower Cook Inlet but occurs at much reduced levels in the upper inlet (SAIC 2002).

Impacts on the plankton communities that form the base of the marine food web may result in impacts on higher trophic organisms (SAIC 2002).

4.2 Benthic Invertebrates

In addition to high turbidity, Cook Inlet is characterized by extreme tidal fluctuations of up to 12.2 meters (40 feet) (NOAA 1999) that produce strong currents in excess of 8 knots (Tarbox and Thorne 1996). The amount of protected benthic habitat is likely reduced by the periodic scouring or substrate movement caused by Cook Inlet currents that bottleneck at the Forelands, near the Osprey Platform (SAIC 2002).

Mollusks, polychates, and bryozoans dominate the infauna of seafloor habitats in Cook Inlet. Feder et al. (1981) found over 370 invertebrate taxa in samples from lower Cook Inlet. Substrates consisting of shell debris generally have the most diverse communities and are dominated by mollusks and bryozoans (Feder and Jewett 1987). Muddy-bottom substrates are occupied by mollusks and polychaetes, while sandy-bottom substrates are dominated by mollusks. Nearshore infauna, where sediments are fine and sedimentation rates are high, consists mostly of mobile deposit-feeding organisms that are widely distributed through the area. Infaunal organisms are important trophic links for crabs, flatfishes, and other organisms common in the waters of Cook Inlet (SAIC 2002).

Chum salmon grow to an average weight of between 7 and 18 pounds. Chum salmon remain nearshore during the summer where their diet consists of small insects and plankton. In the fall, they start moving offshore where they feed on plankton. They return to fresh water in the fall and spawn late in the year. Most chum salmon spawn in areas similar to those used by pink salmon, but sometimes travel great distances up large rivers (e.g., up to 3,218 kilometers (2,000 miles) up the Yukon River). Chum salmon usually return to streams to spawn after 3 to 5 years at sea (SAIC 2002).

Sockeye salmon spawn in stream systems with lakes; fry may reside up to 3 years in fresh water lakes before migrating to sea. Most sockeye spend two to three winters in the North Pacific Ocean before returning to natal streams to spawn and die (SAIC 2002). Sockeye salmon is the most important commercial salmon species in Cook Inlet (ADFG 1999).

Coho salmon return to spawn in natal stream gravels from July to November, usually the last of the five salmon species. Fry emerge in May or June and live in ponds, lakes, and stream pools, feeding on drifting insects (SAIC 2002). Coho salmon may reside in-stream up to three winters before migrating to sea where they typically remain for two winters before returning to spawn (ADFG 1986).

Chinook salmon are the first of the five species to return each season. They reach the Susitna River in approximately mid-May (ADFG 1986). Soon after hatching, most juvenile chinook salmon migrate to sea, but some remain for a year in fresh water. Most chinook salmon return to natal streams to spawn in their fourth or fifth year (SAIC 2002). The Susitna River supports the largest chinook salmon run in upper Cook Inlet which includes systems below the Forelands to the latitude of N 59°46′12″, near Anchor Point (ADFG 1986).

4.3.1.2 Other Anadromous Fish

Steelhead trout (*O. mykiss irideus*) is a rainbow trout that has spent a part of its life in the sea. These fish are unevenly distributed throughout Cook Inlet. Spawning begins in about mid-April and generally continues throughout May and early June. Steelhead trout usually spawn more than once. Eggs are deposited in gravel during the spring and develop into alevins or sac fry. By midsummer, they emerge from the gravel and seek refuge along stream margins and protected areas. Usually, juveniles remain in the parent stream for about 3 years before they enter saltwater (MMS 2003).

Cutthroat trout (*O. clarkii*) are the most common trout species in the region. Resident fish live in a wide variety of environments from small headwater tributaries and bog ponds to large lakes and rivers. Sea-run fish are usually found in river or stream systems with accessible lakes. It is unknown why some fish migrate to sea while others remain in fresh water. Adults spawn in small, isolated headwater streams from late April to early June, and young cutthroat trout emerge from the gravel in July. Sea-run cutthroat rear for 3 to 4 years in fresh water and then migrate to sea during May for a few days to more than 100 days before returning to their home stream (MMS 2003).

Bering cisco (*Coregonis laurettae*) have been reported in the Susitna River drainage (Barrett et al. 1985). Bering cisco enter river systems in the late summer. In 1982, spawning peaked mid-October in the Susitna River (SAIC 2002). Egg incubation occurs over winter and larvae move into northern Cook Inlet after ice-out in the spring from late April to May (Morrow 1980).

Dolly Varden Char (*Salvelinus malma*) that inhabit Cook Inlet can be anadromous or reside in fresh water. Non-resident Dolly Varden cycle seasonally between fresh water and marine environments. They often overwinter in fresh water drainages, then disperse into coastal waters during summer to feed on small fishes and marine invertebrates (Morrow 1980). In Cook Inlet, Dolly Varden spawn annually in rivers during the fall from late August to October (Scott and Crossman 1973; Morrow 1980). Like other salmonids, Dolly Varden lay eggs in hollowed out redds (shallow cavities dug into streambeds where salmonids spawn) located in swift moving water; hatching occurs the following spring. Juvenile Dolly Varden remain in their natal streams for 2 to 3 years (SAIC 2002).

White sturgeon (*Acipenser transmontanus*) are anadromous fish found in northern Cook Inlet. They are believed to spend most of life near shore in water depths of 30 meters or less (98 feet). Although little is known about white sturgeon migrations while in salt water, one tagged specimen was captured 1,056 km (656 miles) from where it was tagged (Morrow 1980). In the spring, most mature white sturgeon enter the estuaries and lower reaches of river systems. They spawn over rocky bottoms in swift water where the sticky eggs adhere to the river bottom. The amount of time needed for the eggs to hatch is not known (SAIC 2002). After spawning, the adults return to sea (Morrow 1980).

4.3.2 Pelagic Fish

Eulachon (*Thaleichthys pacificus*) are small anadromous forage fish (up to approximately 23 cm (9 inches) long; MMS 1995) found throughout the Cook Inlet. Mature eulachon, typically 3 years old, spawn in May soon after ice-out in the lower reaches of streams and rivers. The Susitna River supports a run of eulachon estimated in the millions (Barrett et al. 1985). Females broadcast their eggs over sand or gravel substrates where the eggs anchor to sand grains. Eggs hatch in 30 to 40 days, depending on the water temperature. Eulachon larvae are then flushed out of the drainage and mature in salt water. As juveniles and adults, they feed primarily on copepods and plankton. As the spawning season approaches, eulachon gather in large schools at stream and river mouths. Most eulachon die after spawning (Hart 1973). Eulachon is most important as a food source for other fish, birds, and marine mammals. The Cook Inlet population also supports small dipnet fisheries in upper Cook Inlet (SAIC 2002).

Pacific herring (*Clupea pallasi*) occur in large schools in the Cook Inlet region in early April and potentially through the early fall. These fish generally spawn during the spring. Spawning occurs in shallow, vegetated areas in intertidal and subtidal zones (MMS 2003). Female herring lay adhesive eggs over rock and seaweed substrates. Depending on water temperature, eggs hatch in 3 to 7 weeks. Herring stay nearshore until cold winter water temperatures drive them offshore to deeper, warmer waters. Herring have been harvested for bait in Cook Inlet as far north as the Forelands (Blackburn et al. 1979). The Cook Inlet herring fishery now targets Kamishak Bay on the west side of lower Cook Inlet. A small herring sac roe fishery has been suspended since the 1998 season because of low herring abundance. Alaska Department of Fish and Game biologists observed about 8,100 tons of herring in the Kamishak Bay District in 2000; biomass must exceed a threshold of 8,000 tons before a commercial sac roe harvest can be considered for Kamishak Bay (SAIC 2002).

Pacific sand lance (*Ammodytes hexapterus*) is a schooling fish that sometimes bury themselves in beach sand (Hart 1973). Pacific sand lance spawn within bays and estuaries, typically between December and March (SAIC 2002). Eggs are demersal, but will suspend in turbulent waters (Williams et al. 1964). Pacific sand lance larvae are found both offshore and in intertidal zones (Fitch and Lavenberg 1975; Kobayashi 1961). Early juvenile stages are pelagic, while the adult burrowing behavior develops gradually (Hart 1973). Major food items of the juvenile sand lance include copepods, other small crustaceans, and eggs of many forms (Hart 1973; Fitch and Lavenberg 1975). This species is commonly preyed upon by lingcod, Chinook salmon, halibut, fur seals, and other marine animals (Hart 1973) and appears to be an important forage species. Pacific sand lance have been caught off Chisik Island, southwest of West Foreland (Fechhelm et al. 1999).

Capelin (*Mallotus villosus* [Muller]) is a major forage fish of the Cook Inlet region. Populations of capelin are large and are generally found in pelagic waters. They are mainly filter feeders, thriving on planktonic organisms including euphausiids and copepods. They spawn on beaches and in deeper waters and require specific conditions (e.g., temperature, tide, and light) for successful spawning. Capelin eggs attach to beach and bottom gravels. They hatch, depending on temperature, within 15 to 55 days. These fish currently have no economic value to Alaska, but they are used extensively for food by other fish, marine mammals, and seabirds (MMS 2003).

4.3.3 Groundfish

The Pacific halibut (*Hippoglossus stenolepis*) is a large flatfish that occurs throughout Cook Inlet. Halibut concentrate on spawning grounds along the edge of the continental shelf at water depths of 182 to 455 meters (597–1,493 feet) from November to March. Significant spawning sites in the vicinity of lower Cook Inlet are Portlock Bank, northeast of Kodiak Island, and Chirikof Island, south of Kodiak Island (IPHC 1998). Temperature influences the rate of development, but typically eggs hatch in 20 days at 5°C (ADFG 1986). As eggs develop into larvae, they float in the water column and drift passively with ocean currents. Halibut larvae's specific gravity decreases as they grow. Three- to 5-month old larvae drift in the upper 100 meters (329 feet) of water where they are pushed by winds to shallow sections of the continental shelf. At 6 months old, juveniles settle to the bottom in nearshore waters where they remain for 1 to 3 years (Best and Hardman 1982). Juvenile halibut then move further offshore (IPHC 1998). Halibut migrate seasonally from deeper water in the winter to shallow water in summer. Accordingly, the fishery is most active in deep areas early in the season (i.e., May) whereas activity can be as shallow as 20 meters (about 65 feet) during midsummer. A recreational fishery in central Cook Inlet targets Pacific halibut (SAIC 2002). The Sport Fish Division of the Alaska Department of Fish and Game estimate that 75,709 halibut were caught by sport fishermen in central Cook Inlet between May 1 and July 31, 1995 (McKinley 1996).

Pacific cod (*Gadus macrocephalus*) are distributed over lower Cook Inlet. They are fast-growing bottom-dwellers that mature in approximately 3 years. They may reach lengths of up to 1 meter (Hart 1973). Cod spawn during an extended period through the winter and eggs may hatch in 1 week depending on water temperature. Cod are harvested offshore in the Gulf of Alaska by trawl, longline, pot, and jig gear. Cod move into deep water in autumn and return to shallow water in spring. Pacific cod populations sustain a rapid turnover due to predation and commercial fishing (SAIC 2002). The Gulf of Alaska stock is projected to decline as a result of poor year-classes produced from 1990 to 1994 (Witherell 1999).

Sablefish (*Anoplopama fimbria*) are also known as black cod. They are found within Cook Inlet, and they are a valued commercial species. These fish probably spawn during the spring, but little is known about their spawning behavior or egg-larval development. They feed on a large variety of benthic and pelagic fauna (MMS 2003).

Starry flounder (*Platichthys stellatus*) have been caught in central Cook Inlet (Fechhelm et al. 1999) and are likely to occur in northern Cook Inlet. Starry flounder spawn from February through April in shallow water (Hart 1973). They generally do not migrate, although one starry flounder was caught 200 km (124 miles) from where it had been tagged (Hart 1973). Starry flounder tolerate low salinities, and some have been caught within rivers (SAIC 2002).

Arrowtooth flounder (*Atheresthes stomias*) and yellowfin sole (*Pleuronectes asper*) may also extend into Cook Inlet. Little is known about the life history of these flatfish (SAIC 2002). Arrowtooth flounder larvae have been taken from depths of 200 meters (about 650 feet) to the surface in June off British Columbia (Hart 1973). Both have been caught off Chisik Island in central Cook Inlet (Fechhelm et al. 1999).

Pacific hake (*Merluccius productus*) can be found throughout the Cook Inlet in small numbers. They could spawn up to several months in this region, with the pelagic eggs hatching in as little as 3 days depending on the size of the fish. Larvae hake consume copepods and other similarly-sized organisms while adult hake consume euphausiids, sand lance, anchovies, and other forage fishes. Hake are prey for other marine fish, marine birds, and marine mammals (MMS 2003).

Walleye pollock (*Theragra chalcogramma*) are found throughout the Cook Inlet. They spawn in the spring in large aggregations and there is some extended spawning in smaller numbers throughout the year. Eggs hatch in about 10 to 20 days. Adult fish consume shrimp, sand lance, herring, small salmon, and similar organisms they encounter. Walleye pollock are also cannabilistic (MMS 2003).

Smaller numbers of yellowfin sole, Atka mackerel, and other groundfish inhabit Cook Inlet. These species generally are found in the same habitats as the groundfish species described above (MMS 2003).

4.3.4 Essential Fish Habitat

The 1996 amendments to the Magnuson-Stevens Act (MSA), PL-104-267, which regulate fishing in U.S. waters, included substantial new provisions to protect important habitat for all federally managed species of marine and anadromous fish. The amendments created a new requirement to describe and identify *essential fish habitat* (EFH) in each fishery management plan. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Federal agencies are required to consult with the National Marine Fisheries Service (NMFS) on all actions undertaken by the agency that may adversely affect EFH (SAIC 2002).

This mandate was intended to minimize adverse effects on habitat caused by fishing or non-fishing activities and to identify other actions to encourage the conservation and enhancement of this habitat. Cook Inlet contains EFH for a total of 35 species including walleye pollock, pacific cod, and salmon. Routine operations and accidents can effect EFH by damaging habitats used for breeding, spawning, feeding, or growth to maturity (SAIC 2002).

Fishery management plans are obliged to identify habitat areas of particular concern (HPC) within EFH. HPCs include living substrates in shallow water that provide food and rearing habitat for juvenile fish and spawning grounds that may be impacted by shore-based activities. Estuarine and nearshore habitats of Pacific salmon (e.g., eelgrass [*Zostera sp.*] beds) and herring spawning grounds (e.g., rockweed [*Fucus sp.*] and eelgrass] are HPCs that can be found in Cook Inlet. Offshore HPCs include areas with substrates that serve as cover for organisms including groundfish. Areas of deepwater coral are also considered HPC, but populations are concentrated off southeast Alaska, out of the proposed project area. All anadromous streams qualify as HPC (SAIC 2002).

4.4 SHELLFISH

4.4.1 Razor Clam (Siliqua patula)

This clam is harvested extensively throughout its range by commercial and sports fisheries. Breeding occurs between May and September and is closely associated with rising water temperatures. Toward the end of their larval free-swimming period (veliger stage), which can list 5 to 16 weeks, the shells begin to form, and they start resembling clams. The young clams take up residence in sand. These clams live in surf-swept and somewhat protected sand beaches of the open ocean. Large numbers are found in waters near Augustine Island of western Cook Inlet. They feed on phytoplankton and zooplankton filtered from the surrounding sea water (MMS 2003).

4.4.2 Pacific Weathervane Scallop (Patinopecten caurinus)

These scallops generally are sexually mature at 3 or 4 years of age and are a commercially harvestable size at 6 to 8 years. Spawning occurs in June and July where spermatozoa and ova are released into the water. Ova that are fertilized settle to the bottom and after approximately 1 month, hatching occurs and the larvae drift with the tidal currents. After 2 to 3 weeks, the larvae gain weight, settle to the bottom, and attach themselves to seaweed. There are two scallop beds east of Augustine Island in Cook Inlet that are commercially harvested. Weathervane scallops feed on microscopic plankton that they filter from the surrounding water (MMS 2003).

4.4.3 Pandalid Shrimp

Five species of pandalid shrimp of various commercial and subsistence values are found in the cool waters off the coast of Alaska. Coonstripe shrimp (*Pandalus hypsinotis*) were the target shrimp of Cook Inlet fisheries. Coonstripe shrimp are generally associated with rock piles, coral, and debris-covered bottoms. Pandalid shrimp generally spawn in the fall and hatch in the spring but timing varies with species and range. Females carry fertilized eggs for about 6 months before the eggs hatch into planktonic, free-swimming larvae. After the last larval molt, they transform into juveniles and settle to the bottom. Pandalid shrimp are opportunistic bottom feeders that feed on a wide variety of items including worms, diatoms, detritus, algae, and various invertebrates. They are often the diet of large predator fish including Pacific cod, walleye pollock, flounders, and salmon (MMS 2003).

4.4.4 Dungeness Crab (Cancer magister)

Dungeness crabs are found in Cook Inlet, and they mate from spring through autumn. The female crab extrudes the fertilized eggs under her abdomen and carries them around until they hatch. After hatching, the young crabs take about 4 months to a year before molting into the first of six juvenile stages. Dungeness crabs are widely distributed subtidally and prefer a muddy bottom in the sea. They scavenge for organisms that live partly or completely buried in the sand along the seafloor. They are also predators that will eat shrimp, mussels, small crabs, clams, and worms (MMS 2003).

4.4.5 Tanner Crabs (Chionoecetes bairdi and C. opilio)

Tanner crabs are found in Cook Inlet. After fertilization, eggs are incubated on the female's abdominal flap for a year. Hatching occurs late the following winter and spring, with the peak hatching period usually occurring during April to June. The young, free-swimming larvae molt several times and after several years of growth, females mature at approximately 5 years, and males mature at approximately 6 years. Tanner crabs feed on assorted worms, clams, mussels, snails, crabs, other crustaceans, and fish parts. They are consumed by groundfish, pelagic fish, and humans (MMS 2003).

4.6.2 Shorebirds

Approximately 30 shorebird species occur as breeding birds and migrants in Cook Inlet. Although shorebirds nest in Cook Inlet, the most important areas for shorebird use are the migratory stopover areas in the northern Gulf of Alaska/lower Cook Inlet where birds stop to rest and feed. An important location for shorebirds during migration is western Cook Inlet (DeGange and Sanger 1987). These include the intertidal zones of Drift River, Iniskin Bay, and Chinitna Bay. Kachemak Bay in lower Cook Inlet is also an important feeding and resting area for shorebirds during migration (SAIC 2002).

The Pribilof Islands rock sandpiper (*Calidris ptilocnemis*) winters along the intertidal mudflats from the Susitna River south to Redoubt Bay (Gill and Tibbets 1999). The sandpipers, which begin arriving in November and remain through mid-April, feed on a small bivalve (*Macoma balthica*) found in high densities in the intertidal area. The mean count of the Pribilof Island rock sandpiper during aerial surveys conducted in winter (1997 to 1999) was 17,530 birds (MMS 2003).

During spring migration, millions of shorebirds congregate at coastal intertidal mudflats to feed before continuing their northward migration. Most birds pass through the area between late April and mid-May with the peak of the migration in early May. The two most common species are dunlin and western sandpiper. Turnover is high, and individual birds probably only stop to feed and rest for a few days before continuing (SAIC 2002).

4.6.3 Waterfowl

The most abundant waterfowl species in lower Cook Inlet (MMS 2003) include scoters, long-tailed ducks, eiders, and goldeneyes (Agler et al. 1995). Large numbers of waterfowl migrate through the Cook Inlet area in the spring (Arneson 1980; Gill and Tibbitts 1999). Waterfowl densities increase in winter and are higher in eastern Cook Inlet than on the western side (Arneson 1980). Sea ducks feed primarily on benthic invertebrates, including clams and mussels (Sanger and Jones 1984).

4.6.4 Coastal Birds of Prey

The bald eagle is a breeding, year-round resident along the coast of lower Cook Inlet (MMS 1995). Populations in southeastern Alaska have been stable or increasing. Bald eagles feed primarily on fish or act as scavengers (MMS 2003).

4.7 NONENDANGERED MARINE MAMMALS

Marine mammals that range throughout the Gulf of Alaska, including Cook Inlet, are described below. These species are protected under the Marine Mammal Protection Act (MMPA) and are managed by the U.S. Fish and Wildlife Service (USFWS) and NMFS (SAIC 2002).

4.7.1 Minke Whale (Balaenoptera acutorostrata)

Minke whales occur in the North Pacific from the Bering and Chukchi Sea south to near the equator (Leatherwood et al. 1982). Minke whales are relatively common in the nearshore waters of the Gulf of Alaska (Mizroch 1992) but are not abundant in any other part of the eastern Pacific (Brueggeman et al. 1990). Minke whales are unlikely to migrate into Cook Inlet, but it is possible (SAIC 2002).

Minke whales breed in temperate or subtropical waters throughout the year (SAIC 2002). Peaks of breeding activity occur in January and June (Leatherwood et al. 1982). Calving occurs in winter and spring (Stewart and Leatherwood 1985). Females are capable of calving each year (SAIC 2002), but a 2-year calving interval is more typical (Leatherwood et al. 1982).

Minke whales in the North Pacific prey mostly on euphausiids and copepods (SAIC 2002) but also feed on schooling fishes including Pacific sand lance, northern anchovy, and squid (Leatherwood et al. 1982; Stewart and Leatherwood 1985; Horwood 1990).

No estimates of the number of minke whales in the north Pacific or Alaskan waters have been made (Hill and DeMaster 2000). The annual human-caused mortality is considered insignificant (SAIC 2002). Minke whales in Alaska are not listed as depleted under the MMPA or considered a strategic stock (Hill and DeMaster 2000).

4.7.2 Gray Whale (Eschrichtius robustus)

Gray whales historically inhabited both the North Atlantic and North Pacific oceans. A relic population survives in the western Pacific. The eastern Pacific or California gray whale population has recovered significantly and now numbers about 23,000 (Hill et al. 1997). The eastern population has recovered significantly and now numbers about 23,000 (Hill et al. 1997). The eastern Pacific stock was removed from the Endangered Species List in 1994 and is not considered a strategic stock by the NMFS (SAIC 2002).

The eastern Pacific gray whale breeds and calves in the protected waters along the west coast of Baja, California and the east coast of the Gulf of California from January to April (Swartz and Jones 1981; Jones and Swartz 1984). At the end of the breeding and calving season, most of these gray whales migrate about 8,000 km (5,000 mi) north, generally along the west coast of North America, to the main summer feeding grounds in the northern Bering and Chukchi seas (SAIC, 2002).

Gray whale occurrences in Cook Inlet are most likely uncommon. As they move through the Gulf of Alaska on their northward and southward migrations, gray whales closely follow the coastline (Calkins 1986). They generally tend to bypass Cook Inlet as they pass through the Barren Islands and the waters south of Kodiak Island (Calkins 1986). However, a cow and a calf were observed in lower Cook Inlet as recently as the summer of 2000 (Eagleton 2000).

4.7.3 Killer Whale (Orcinus orca)

Killer whales occur along the entire Alaska coast (Dahlheim et al. 1997) from the Chukchi Sea, into the Bering Sea, along the Aleutian Islands, Gulf of Alaska. and into Southeast Alaska (Braham and Dahlheim 1982). Seasonal concentrations occur in

Shelikof Strait and the waters around Kodiak Island (Calkins 1986). Killer whales are known to inhabit Cook Inlet waters during the summer and have been observed pursuing beluga whales in Cook Inlet (Eagleton 2000). Killer whales using Cook Inlet are most likely from the Eastern North Pacific Northern resident stock of killer whales (SAIC 2002), which is estimated at 717 individuals (Hill and DeMaster 1999). The killer whale population is regarded as abundant in the Gulf of Alaska and Cook Inlet region (MMS 2003). The peak breeding period is May through July (Nishiwaki and Handa 1958, as cited by Consiglieri et al. 1982).

4.7.4 Harbor Porpoise (Phocoena phocoeana)

The harbor porpoise is distributed in waters along the continental shelf and is most frequently found in cool waters with high prey concentrations (Watts and Gaskin 1985). The range of the harbor porpoise within the eastern North Pacific Ocean is primarily restricted to coastal waters and extends from Point Barrow, along the coast of Alaska (SAIC 2002), and the west coast of North America to Point Conception, California (Gaskin 1984). They have been observed in Cook Inlet during winter months (Hansen and Hubbard 1999). Harbor porpoise densities are much greater in their southern range (Washington, northern Oregon and California) than in Alaskan waters (MMS, 2003). Harbor porpoises are not migratory. Little information on the population dynamics of harbor porpoises is known; however, they occur in Cook Inlet (Calkins 1983). The most recent population estimate for the harbor porpoise in Alaskan waters is 30,000 (Hill and DeMaster 1999).

The major predators on harbor porpoises are great white sharks and killer whales. Unlike other delphinids, harbor porpoises forage independently, feeding on small schooling fishes such as northern anchovy as well as squid (SAIC 2002).

4.7.5 Dall's Porpoise (Phocoenoides dalli)

Dall's porpoises are widely distributed along the continental shelf (SAIC 2002) as far north as 65°N (Buckland et al. 1993) and are abundant throughout the Gulf of Alaska (Calkins 1986). Dall's porpoises prefer water depths greater than 20 meters (66 feet) deep (SAIC 2002) and are commonly found in lower Cook Inlet (Calkins 1983). The only apparent gaps in their distribution in the Gulf of Alaska are in upper Cook Inlet and Icy Bay (Consiglieri and Braham 1982). The current estimate for the Alaska stock of Dall's porpoises (SAIC 2002) is 83,400 (Hill and DeMaster 1999). Dall's porpoises (MMS 2003) feed on squid, crustaceans, and deepwater fish (Leatherwood and Reeves 1987).

4.7.6 Harbor Seal (Phoca vitulina richardsi)

Harbor seals range from Baja California, north along the western coast of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and the Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. Hill and DeMaster (2000) estimated 29,000 individuals in the Gulf of Alaska stock (SAIC 2002). The Gulf of Alaska populations around Kodiak and Tugidak Islands have grown since the early 1990s (Small 1996; Withrow and Loughlin 1997) but overall, the stock numbers are in decline (Hill and DeMaster 2000). They are distributed in coastal waters along virtually the entire lower Cook Inlet coastline and are generally nonmigratory. Current population estimates for Cook Inlet are 2,244 (MMS 2003).

Harbor seals inhabit estuarine and coastal waters, hauling out on rocks, reefs, beaches, and glacial ice flows. They are generally nonmigratory, but move locally with the tides, weather, season, food availability, and reproduction activities (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969; Bigg 1981). Female harbor seals give birth to a single pup while hauled out on shore or on glacial ice flows. The mother and pup remain together until weaning occurs at 3 to 6 weeks (Bishop 1967; Bigg 1969). Little is known about breeding behavior in harbor seals. When molting, seals spend the majority of the time hauled out on shore, glacial ice, or other substrates. Harbor seals consume a variety of prey in estuarine and marine waters. Prey type varies regionally and seasonally in the Gulf of Alaska. Walleye pollock are the dominant prey in the eastern Gulf, and octopus are the dominant prey in the western Gulf (SAIC 2002).

4.7.7 Other Nonendangered Marine Mammals

Occasionally, Pacific walruses are sighted in the Cook Inlet area. These unusual sightings generally occur during the winter or spring during years when the Bering Sea pack ice extends into the southern Bering Sea and near the Aleutian Islands. Stray walruses apparently move through the passes into the Gulf of Alaska/Shelikof Strait into Cook Inlet (MMS 2003).

Other nonendangered marine mammals that rarely or infrequently occur in the Gulf of Alaska and Cook Inlet region (MMS 2003), include the short-finned pilot whale, Risso's dolphin, northern right whale dolphin, north Pacific giant bottlenose whale, goosebeak whale, and Bering Sea beaked whale (Consiglieri et al. 1982).

5.0 POTENTIAL IMPACTS OF DISCHARGES ON MARINE ORGANISMS

5.1 CHEMICAL TOXICITY OF DISCHARGES

5.1.1 Drilling Fluids Toxicity

Drilling fluids (muds) are complex mixtures, and there appears to be no single explanation for toxicity. Some of the apparent (actual) toxicity may be due to physical effects, such as particle size coagulations, abrasions, and so on. There is, however, a form of toxicity producing and contributing, in part or in combination with chemical toxicity, to the end points (death) of the organism in acute toxicity tests (Tetra Tech 2006).

Oxygen demand appears strongly correlated with toxicity in laboratory toxicity tests. Spearman Rank correlations of 96-hour LC_{50} data and BOD/UOD data showed a remarkably strong correlation, especially with BOD_5 data derived with artificial sea water and activated seed. These data showed a correlation of 0.97 with toxicity. All BOD/UOD values showed correlations of 0.87 to 0.97 (BOD) and 0.91 to 0.95 (UOD), but TOC/chemical oxygen demand (COD) values gave correlations of 0.64 to 0.67. Given the absence of oxygen demand data, no such correlation could be developed for nongeneric fluids. Another indicator of the large inherent oxygen demand of drilling fluids is that dissolved oxygen levels in test environments dropped below normal, despite the continuous aeration of test media that followed pre-aeration of the test material. This was especially noted during the first day of testing, during which dissolved oxygen levels were depressed concentration dependently by the test fluids (EPA 2000).

A variety of Alaskan marine organisms have been exposed to drilling fluid in laboratory or field experiments. Most of these studies have addressed short-term acute effects in a relative or *screening* sense, with little effort directed at separating chemical from physical causes. A few studies have looked at chronic sublethal effects and bioaccumulation of heavy metals from drilling fluid. Chronic refers to a stimulus that lingers or continues for a relatively long period of time, often one-tenth of the life span of an organism or more (USEPA 1991). Chronic tests assess the effect on survivability, growth, maturation, or reproduction, and the results are typically reported as median effective concentrations (EC_{50}s [concentrations at which a designated effect is displayed by 50 percent of the test organisms]). Because drilling discharges are episodic and typically only a few hours in duration, organisms that live in the water column are not likely to have long-term exposures to drilling fluids; risks to these organisms are best assessed using acute toxicity data. Benthic organisms, particularly sessile species, are likely to be exposed for longer time periods; risks to these organisms are best assessed with chronic toxicity data (Tetra Tech 2006).

Drilling fluid toxicity tests have been performed using whole fluids or various component fractions, such as the suspended particulate phase or fluid aqueous fraction. The variability and complexity in the composition of fluids is reflected in the results and interpretation of toxicity tests. Test results of sample splits of the same fluid performed at two different laboratories have differed by an order of magnitude. In such cases, laboratory procedure or sample handling is a significant factor. Different batches of the same generic fluid have shown significantly different toxicities. In this case, different proportions of major constituents (as allowed by fluid type definition) may be a factor. EPA has attempted to improve consistency in toxicity test results by requiring standard procedures for sample handling and testing that has resulted in consistent test results. The current effluent guidelines require toxicity testing for the suspended particulate phase. The extrapolation of single species toxicity tests to overall effects in the ecosystem still has a large, inherent uncertainty (Tetra Tech 2006).

5.1.1.1 Acute Lethal and Sublethal Effects

The effects of drilling fluids on biological organisms are most commonly assessed by conducting acute laboratory toxicity tests. Unfortunately, in many cases, comparison of toxicity test results obtained in different studies are difficult because different drilling fluids were used, the animals were exposed to different portions of drilling fluid (liquid, suspended particulates, or solids) that may have been prepared in a different manner, or experimental procedures differed between investigators. Nevertheless, results obtained in the majority of studies to date have generally indicated low toxicity (Tetra Tech 2006).

In a summary of over 415 toxicity tests of 68 fluids using 70 species, 1–2 percent exhibited LC_{50}s ranging from 100 to 999 ppm, 6 percent exhibited LC_{50}s ranging from 1,000 to 9,999 ppm, 46 percent exhibited LC_{50}s ranging from 10,000 to 99,999 ppm, and 44 percent exhibited LC_{50}s greater than 100,000 ppm (USEPA 1985b). Two to three percent of the data were not usable. A significant difference was noted between the toxicity of generic fluids, which appear to have acute, lethal toxicity characteristics similar to the distribution of the larger data set described above, and a series of 11 nongeneric fluids provided to EPA by the Petroleum Equipment Supplies Association. These latter fluids, as a group, appear to be substantially more toxic than would be anticipated from the toxicity distribution of either the generic fluids or the larger data set. Whole fluids appear to be more toxic than aqueous or particulate fractions. The suspended particulate phase appears to be more toxic than the other individual phases (Tetra Tech 2006).

Under the proposed NPDES general permit, discharge of fluids with an LC_{50} of less than 30,000 ppm SPP (suspended particulate phase) is prohibited. The toxicity (LC_{50}) of the fluids used to drill 39 production wells in Cook Inlet between August 1987 and February 1991 (under older permits) ranged from 1,955 to greater than 1,000,000 parts per million for a marine shrimp (Tetra Tech 2006). The percentage of the wells with toxicities

- greater than 100,000 parts per million was 79 percent
- between 10,000 and 100,000 parts per million was 10 percent
- between 1,000 and 10,000 parts per million was 10 percent (MMS 2003)

Drilling fluid toxicity data compiled by EPA Region 10 from Alaskan exploratory and production wells indicate that the fluids used in all current and recent operations are acutely toxic only to a slight degree to *Mysidopsis bahia.* LC_{50}s for the 91 valid toxicity test data points ranged from 2,704 to 1,000,000 ppm SPP with a mean of 540,800 ppm. Only 7 of the 91 tests had LC_{50}s less than the 30,000 ppm limit. Some of the records in this database were not included in the above statistics due to pH or other protocol breaches, incomplete reports, and other reasons. (Tetra Tech 2006).

Petrazzuolo (1981) has ranked organisms according to their sensitivity to drilling fluids in tests and found the following order of decreasing sensitivity: copepods and other plankton, shrimp, lobsters, mysids and finfish, bivalves, crabs, amphipods, echinoderms, gastropods, and polychaetes, and isopods. Larval organisms are more sensitive than adult stages (maximally 20-fold); animals are more susceptible during molting (Tetra Tech 2006).

The majority of Alaskan organisms apparently show high tolerance to acute exposure to drilling fluid. Sublethal effects observed following acute exposure have included alteration of respiration and filtration rates, enzyme activities, and behavior. There are several Alaskan taxa that have not been exposed to drilling fluid but may be relatively sensitive. The temperate copepod, *Acartia tonsa,* has exhibited one of the lowest LC_{50}s (100 ppm) of any organism in a drilling fluid. Alaskan copepods have not been tested, but there is no reason to believe their tolerances would fall outside variability in tolerances of other marine copepods (Tetra Tech 2006).

In general, planktonic and larval forms appear to be the most sensitive of the Alaskan organisms that have been exposed to drilling fluid in acute lethal bioassays; however, not all planktonic organisms are sensitive to short-term exposure to drilling fluids. Carls and Rice (1981) found several drilling fluids to have low toxicity to the larvae of six Alaskan species of shrimp and crab. The 96-hour LC_{50}s for the suspended particulates phase of a drilling fluid sea water mixture ranged from 500 to 9,400 ppm. Toxicity was far less when the particulates were removed: the 96-hour LC_{50}s ranged from 5,800 to 119,000 ppm (Tetra Tech 2006).

Houghton et al. (1981) conducted a study on several species of crustaceans, including a shrimp (*Pandalus hypsinotus*), a mysid (*Neomysis integer*), an amphipod (*Eogammarus confervicolus*), and an isopod (*Gnorimosphaeroma oregonensis*), and pink salmon fry (*Onchorhyncus gorbuscha*). These species were exposed to used high-density lignosulfonate drilling fluid from lower Cook Inlet, Alaska. Pink salmon fry were the most sensitive with a 96-hour LC_{50} of 3,000 ppm for SSP. The lowest crustacean concentration was ten times higher (Avanti 1991).

Seven arctic polymer drilling fluids were used for toxicity testing of salmon (Houghton et al. 1981). Five of the seven fluids displayed a 96-hour LC_{50} of less than 40,000 ppm for the SSP fraction; the most toxic fluid had a 96-hour LC_{50} of 15,000 ppm, and the least toxic fluid a 96-hour LC_{50} of 190,000 ppm. Clam worms (polychaetes), soft-shelled clams, purple shore crabs, and sand fleas had approximately the same sensitivity to the fluids as did the salmon. These invertebrate 96-hour LC_{50}s ranged from 10,000 to more than 560,000 ppm (Avanti 1991).

Unlike the water-based drilling fluids, the synthetic-based drilling fluids (SBFs) are water insoluble and do not disperse in the water column as do water-based drilling fluids, but rather sink to the bottom with little dispersion (USEPA 2000). Since 1984, EPA has used the suspended particulate phase toxicity test, an aqueous-phase toxicity test, to evaluate the toxicity of drilling fluids, including SBFs. Using the SPP toxicity test, SBFs have routinely been found to have low toxicity; however, an inter-laboratory variability study indicated that SPP toxicity results are highly variable when applied to SBFs (USEPA 2000). In general, benthic test organisms appear to be more sensitive to the SBFs than water-column organisms. The ranking for SBF toxicity from least toxic to most toxic is: esters < internal olefins < linear alpha olefins < polyalphaolefins < paraffins (USEPA 2000).

5.1.1.2 Chronic Effects

Few studies have evaluated impacts on Alaskan species following chronic exposure to drilling fluids; the species that have been tested are all invertebrates. The few chronic data are consistent, however, and indicate that chronic lethal toxicity is not likely to be more than some 20-fold greater than acute lethal toxicity; chronic sublethal toxicity appears to range from 3-fold to 75-fold greater than acute lethal toxicity, which is within the same range as chronic lethal effects. However, the chronic sublethal data are much more difficult to interpret, physiologically and ecologically. Sample sizes routinely are very small. Most importantly, observations that sublethal effects occur *close* to lethal effect levels miss the point; for most studies, changes were also noted at the lowest level tested. Thus, estimating No-Observable-Effect-Levels (NOELs) are not possible for much of the reported data (Tetra Tech 2006).

Laboratory studies on recruitment and development of benthic communities suggest that drilling fluid and barite can affect recruitment and alter benthic communities or depress abundances. These data are corroborated by results from artificial substrate experiments conducted in the Beaufort Sea; these showed significantly different colonization rates at drilling fluid test plots and control plots, especially for amphipods and copepods (Tetra Tech 2006).

The lowest reported concentration of drilling fluid producing a significant sublethal chronic effect was 50 mg/L for 30 days of continuous exposure with bay mussels, and there was no attempt to separate chemical from physical effects (USEPA 1985b).

A laboratory study examined the chronic toxicity of cuttings from Beaufort Sea wells on the sand dollar *(Echinarachnius parma)* (Osborne and Leeder 1989). Exposure to mixtures as low as 10 percent cuttings and 90 percent sand were found to affect the survival of the benthic organisms, with 100 percent mortality occurring within 23 days in some test cases (Tetra Tech 2006).

5.1.2 Toxicity of Mineral and Diesel Oil

In the past, the oil industry has added diesel oil to drilling fluid systems to free stuck drilling pipes and for other specialized applications. Diesel oil is highly toxic to aquatic life, and much of the toxicity of drilling fluids has been attributed to its presence. Studies have found high correlations of toxicity with added diesel and mineral oil to whole fluid (diesel oil r = 0.88; mineral oil r = 0.97). Toxicity did not correlate quite as well with the oil levels determined in a variety of fluid samples (r = 0.81). The available data indicate that this may be partially due to various types of sequestrations within the drilling fluid matrix as well as the variable presence of toxic constituents in drilling fluids other than diesel or mineral oil (Tetra Tech 2006).

Because of the toxicity of diesel oil, EPA has prohibited its discharge in fluids and cuttings. Instead, EPA allows the use of mineral oils to free stuck pipes and the discharge of residual amounts of mineral oil pills, provided that the pill and a buffer of drilling fluid on either side of the pill are removed and not discharged. The residual mineral oil concentration in the discharged fluid should not exceed 2 percent (volume-volume [v/v]) and must comply with all previous permit conditions (Tetra Tech 2006).

According to the API Hydrocarbon Usage Survey and the OOC Spotting Fluid Survey (USEPA 1993a), diesel oil was still being used for lubricity agents and spotting fluids as of 1986 (Tetra Tech 2006). With the advent of Best Practicable Control Technology Currently Available (BPT) effluent limitation guidelines, however, current diesel oil usage for these purposes is assumed to be zero (USEPA 1993a).

Mineral oils differ from diesel oils in that they contain a lower concentration of aromatic hydrocarbons (15–20 percent vs. 20–61 percent for diesel oil). In addition, saturated aliphatics (paraffinics) generally represent a larger percentage of mineral oils compared to diesel oil. Aromatic hydrocarbons are generally more toxic and resist biodegradation to a greater degree than do paraffinics (Petrazzuolo 1983a). Research studies indicate that some mineral oils are much less acutely toxic (5 to 30 times less) to certain marine organisms than diesel oil (Tetra Tech 2006). Despite the reduced toxicity of some mineral oils as compared to diesel oils, mineral oils do contribute potentially toxic organic pollutants to drilling fluids to which they are added (Tetra Tech 2006).

Neither mineral nor diesel oils possess constituents that can be biomagnified. The hazard to aquatic life from consuming organisms or inhabiting water contaminated with diesel oils is greater than that for mineral oil because the aromatics in diesel oils tend to be more soluble and biologically active than paraffinic hydrocarbons, although the PAHs contained in mineral oils have been shown to be highly soluble in adipose tissue and lipids (Sittig 1985). Organisms will assimilate hydrocarbons in both types of petroleum products, but the hazard associated with the residues is not expected to be significant (Tetra Tech 2006).

5.1.3 Toxicity of Produced Waters

In addition to fluid and cuttings, produced water constitutes a major discharge from offshore production operations. Water brought up from the hydrocarbon-bearing strata with the produced oil and gas includes brines trapped with the oil and gas in the formation and possibly water that was injected into the reservoir to increase productivity. (Water injected to increase hydrocarbon recovery is normally injected into wells other than the producing wells.) The actual amount of produced water derived from each site is a function of the geological formation encountered and the method of recovery. The proportion of water in the produced fluids may vary from 0 to over 90 percent and can increase, decrease, or remain constant over the lifetime of a well (Menzie 1982). In Cook Inlet, produced fluids have increased in water content as most fields have matured. The generation of produced water is a relatively continuous feature of producing platforms, unlike the intermittent discharge of drilling fluid and cuttings from exploration, development, and production operations (Avanti 1991).

Brines are the major form of produced water, and the major inorganic constituents are chlorides. Menzie (1982) reports typical dissolved solids concentrations of 80,000–100,000 mg/L in produced water, although a range from a few mg/L to approximately 300,000 mg/L has been observed. In comparison, sea water of 30 ppt salinity has a dissolved concentration of 30,000 mg/L (Avanti 1991). In upper Cook Inlet, dissolved solids concentrations in produced waters are typically 24,700 mg/L (Lysyj and Curran 1983).

In most oil fields, treatment of the total fluid to separate oils from produced water ranges from simple gravity separation at offshore facilities to multi-step processes at centralized onshore facilities. Any gas co-produced with the oil is separated out. Use of the multi-step processes can lead to reduction of oil content, volatile aliphatic hydrocarbons, and volatile aromatic hydrocarbons. The gas is either flared at the platforms, used for energy, or sold and is not part of the final discharge (Avanti 1991).

Potential biological effects occurring as a result of produced water discharges include osmotic stress if salinity varies significantly from ambient sea water, respiratory stress if DO levels are low, bioaccumulation of various components, and toxic effects from hydrocarbon and heavy metal constituents. The probability of these effects occurring in Cook Inlet is a function of the total volume discharged within the waterbody and the dilution and dispersion of the effluent plume. The latter also may be affected by salinity of the discharge. Low saline produced water (relative to ambient sea water) will tend to rise to the surface, whereas briny produced water will tend to sink to the bottom layer. The mixing rates of these types of discharges depend on current and wave conditions and the density difference between the effluent and the receiving water (Avanti 1991).

If the salinity of the produced water is similar to ambient sea water, osmotic stress is improbable and respiratory stress is likely to be restricted to localized, nearfield areas. Minimal impact of this type is likely unless the quantity (volume) of discharge is such that DO is measurably depressed within the water mass. This is most likely to occur only in shallow, poorly flushed embayments (Avanti 1991).

5.1.3.1 Acute Lethal Effects

The toxicity of the produced waters from the oil and gas fields of upper Cook Inlet was determined by using a standard 96-hour static acute-toxicity test to the mysid shrimp *Mysidopsis bahia* (EBASCO Environmental 1990a); this test measures the concentration killing 50 percent of the test animals in 96 hours (LC_{50}). (*M. bahia* routinely has been used to evaluate the toxicity of effluents from municipal wastewater treatment plants, refineries, and chemical manufacturing plants to marine organisms [Brown et al. 1992]). The LC_{50} toxicities of the produced waters ranged from 0.27–82.47 percent of the effluent (Table III.A-9); these concentrations equal 2,700–824,700 parts per million. On the basis of the qualitative toxicity levels described in section IV.B.1.a(3)(c)1), the produced waters sampled during the Cook Inlet Discharge Monitoring Study Program would range in toxicity from slightly toxic to practically nontoxic prior to discharge and subsequent mixing in the water column (MMS 2003).

5.1.3.2 Chronic and Sublethal Effects

Although the acute toxic effects of produced water appear to be low (when biocides are absent), chronic lethal and sublethal effects must be considered. Such effects are expected to occur at concentrations below those that are acutely toxic. Chronic exposures to organisms in the water column could occur in areas where the hydrocarbons discharged to the water column are not rapidly removed from the system and where there is a continuous input. The potential for buildup of hydrocarbons in the water column would be greater in semi-enclosed coastal embayments with limited flushing than in offshore regions (Avanti 1991).

In areas where a hypersaline produced water plume contacts the bottom, mortality can be expected to occur as a result of anoxic and hypersaline conditions. The extent of these effects will depend on the duration, volume, and dispersion of the plume. It is likely that the benthic community, especially infauna and less mobile epiphauna, would be severely disrupted in the immediate vicinity of the discharge. Armstrong et al. (1979) noted severe disruption of benthos within 150 meters (490 feet) of the discharge point in Trinity Bay, Texas (Avanti 1991).

Farther from the discharge site, chronic effects may occur and are likely to impact benthos over a larger area. Chronic effects may occur primarily from exposure to dissolved or deposited materials and hydrocarbons (Avanti 1991). In other areas, it has been noted that compounds at very low concentrations in produced water, especially substituted napthalenes, can accumulate to high concentrations in sediments and in biota (Armstrong et al. 1979). This occurs even in areas where the discharge plume dilutes rapidly (Armstrong et al. 1979).

5.1.3.3 Bioaccumulation Potential of Produced Water

The environmental accumulation potential of selected trace metal and organic constituents of produced waters has been previously estimated from predetermined sorption coefficients (K_d) and bioconcentration factors (BCFs). On the basis of data derived from the ODCE for Southern California (JRB Associates 1984) as shown in

Table 4, the affinity of trace metals to suspended particulate matter or sediments (i.e., their partitioning potential) is very high. Among the elements studied, lead, manganese, and mercury have the highest coefficient value; chromium, copper, silver, and zinc comprise a group that has medium partitioning potential; antimony, arsenic, iron, cadmium, nickel, selenium, and thallium show the lowest potential as compared to the other elements. The range of BCF values for each element is large, and therefore, definitive patterns cannot be deciphered. However, looking at the maximum estimated values, it appears that zinc, thallium, mercury, and cadmium exhibit the highest bioaccumulation potential, with antimony, arsenic, and copper sharing a medium tendency, and silver, selenium, nickel, lead, chromium, and beryllium exhibiting the lowest values (Avanti 1991).

For trace organic constituents evaluated in the Southern California study (JRB Associates 1984), benzo(a)pyrene has the highest sorption value followed by three compounds having similar K_d values (acenaphthalene, phenanthrene, and anthracene) but of lower magnitude (one or two orders of magnitude). Benzene and toluene, being volatile compounds have the least tendency for sorption. All the listed compounds except the volatiles and naphthalene show similar bioaccumulation capacity (Avanti 1991).

On the basis of the magnitude of the K_d and BCF values listed in Table 4, each of the constituents were ranked according to their relative environmental accumulation potential. The rankings are designated as high (H), medium (M), low (L) and combinations among these. These rankings, coupled with the rankings for toxicity, should present a first approximate determination of which compounds appear to be of concern (Avanti 1991).

Table 4. Estimated Accumulation Factors of Selected Trace Metals and Petroleum Components in Produced Waters.

Component	Sorption[1] coefficient ($K_d \times 10^4$)	Bioaccumulation[2] factor (BCF x 10^4)	Relative accumulation potential
	Trace Metals		
Antimony	2	0.004-2	L
Arsenic	2	0.003-2	L
Beryllium	1	0.01	L
Cadmium	6	0.01-10	M
Chromium	30	0.001-0.1	M
Copper	20	0.01-0.1	M
Lead	90	0.001-0.01	MH
Manganese	100	NA	UND[3]
Mercury	250	0.1-10	H
Nickel	8	0.001-0.1	L
Selenium	6	0.01	L
Silver	20	0.01-0.1	M
Thallium	3	0.001-10	MH
Zinc	20	0.01-10	MH
	Hydrocarbons		
Benzene	0.0019	0.0045	L
Toluene	0.0023	0.0052	L
Xylene	NA	NA	UND
Naphthalene	0.026	0.035	ML

Table 4. Estimated Accumulation Factors of Selected Trace Metals and Petroleum Components in Produced Waters. (Continued)

Component	Sorption[1] coefficient ($K_d \times 10^4$)	Bioaccumulation[2] factor (BCF x 10^4)	Relative accumulation potential
	Hydrocarbons		
Anthracene	0.25	0.035	M
Phenanthrene	0.30	0.22	M
Benzo(a)pyrene	15.14	0.1	H
Ethylbenzene	NA	NA	UND
Acenaphthalene	0.12	0.12	M

Source: JRB Associates 1984.

1 Sorption coefficients for trace metals were determined from field measurements in estuarine waters; coefficients for the organic constituents were estimated from octanol/water partition coefficient.

2 Bioaccumulation factors for trace metals were estimated from Versar (1979) as cited in JRB Associates 1984; trace organics were estimated from octanol/water partition coefficients.

3 UND = Undetermined.

5.1.4 Toxicity of Other Discharges

Sea water is the principal component of most of the other permitted discharges associated with oil- and gas-production activities in Cook Inlet, and in some cases, it is the only constituent. There is a wide range of concentrations of the various additives in the discharges. Produced water treatment additives include biocides, scale inhibitors, emulsion breakers, and corrosion inhibitors (MMS 2003). The range of maximum concentrations and toxicities (96-hour LC_{50}) for the (1) biocides is about 5–640 ppm, (2) scale inhibitors is about 30–160 ppm, (3) emulsion breakers is about 10 ppm, and (4) corrosion inhibitors is about 20–160 ppm (Neff 1991).

5.1.5 Metals Accumulation Potential

The potential accumulation of metallic compounds in biota represents an issue of concern in the assessment of oil and gas impacts. Sublethal effects resulting from bioaccumulation of these highly persistent compounds are most often measured. Gross metal contamination from drill fluids might also cause mortality, particularly in benthic species. Sources of metals include drill fluids, formation waters, sacrificial anodes, and contamination from other minor sources. Drill fluids and formation waters are the primary sources of concern for arsenic, barium, chromium, cadmium, copper, mercury, nickel, lead, vanadium, silver, and zinc (Avanti 1991).

Field studies of metal concentrations in sediment around platforms suggest that enrichment of certain metals may occur in surface sediments around platforms (Tillery and Thomas 1980; Mariani et al. 1980; Crippen et al. 1980; and others). In the review of these studies conducted by Petrazzuolo (1983b), enrichment of metals around platforms is generally distance dependent with maximum enrichment factors seldom exceeding 10. In platforms studied, enrichment of metals that could be attributed to drilling activities was either generally distributed 300–500 meters around the platform, or distributed downcurrent in a plume to a larger distance from the structure (Avanti 1991).

The concentrations of metals required to produce physiological or behavioral changes in organisms vary widely and are determined by factors such as the physiological characteristics of the water and sediments, the bioavailability of the metal, the organism's size, physiological characteristics, and feeding adaptations. Metals are accumulated at different rates and to different concentrations depending on the tissue or organ involved. Laboratory studies on metal accumulations as a result of exposure to drill fluids have been conducted by Tornberg et al. (1980), Brannon and Rao (1979), Page et al. (1980), McCulloch et al. (1980), Liss et al. (1980), and others. Maximum enrichment factors for the metals measured were generally low (< 10) with the exception of barium and chromium, which had enrichment factors of up to 300 and 36, respectively (Avanti 1991).

Depuration studies conducted by Brannon and Rao (1979), McCullough et al. (1980), and Liss et al. (1980) have shown that organisms tested have the ability to depurate some metals when removed from a zone of contamination. In various tests, animals were exposed to drill fluids from 4–28 days, followed by a 1–14 day depuration period. Uptake and depuration of barium, chromium, lead, and silver were monitored and showed a 40–90 percent decrease in excess metal in tissues following the depuration period. Longer exposure generally meant a slower rate of loss of the metal. In addition, if uptake was through food organisms rather than a solute, release of the excess metal was slowed (Avanti 1991).

The available laboratory data on metals accumulation are difficult to correlate with field exposure and accumulation. Petrazzuolo's review (1983b) notes that in the field, bioaccumulation of metals in the benthos will result from exposure to the particulate components of drilling fluids. However, laboratory studies have almost always used either whole fluids or fluid-aqueous fractions, and thus are either over- or underestimating potential accumulation (Avanti 1991).

Field studies of metal accumulation in marine food webs off southern California have been conducted by Schaefer et al. (1982) and others. These data have indicated that most metals measured (including chromium, copper, cadmium, silver, and zinc) do not increase with trophic level either in open water or in contaminated regions such as coastal sewage outfalls. Mercury, however, may be an exception to this, as biomagnification has been observed in a number of studies. Other studies have shown that croakers, scorpionfish, and sea urchins can detoxify inorganic metals through a protein synthesis process that excludes contaminants from cellular enzyme pools (Avanti 1991).

Bioaccumulation of metals in southern and central California offshore waters may not be a significant environmental problem. However, Petrazzuolo (1983b) states that due to the persistence of metals, the high toxicity of some metals, the paucity of laboratory data on mercury, and the inability to correlate field and laboratory measures, a finding of no significant potential effect is inappropriate at this time (Avanti 1991).

5.2 HUMAN HEALTH IMPACTS

Adverse human health effects from drilling fluids and produced water are unlikely to result from the exploration and production discharges because direct human exposure will be low. Ingestion of organisms that have accumulated significant concentrations of heavy metals or other contaminants from drilling fluids and produced water is the potential principal source of adverse human health effects caused by offshore oil and gas drilling operations. Three metals are of special concern: mercury and cadmium because they biomagnify in food webs, and barium, which is present in large concentrations in drilling fluids. Benzo(a)pyrene is also of special concern because of its presence in produced waters. Barium could accumulate in marine organisms, but human ingestion of contaminated seafood in a short enough period of time to pose a human health threat is unlikely. Petrazzuolo (1981) assessed human health risk on the basis of reported barium concentrations in biota and concluded that a human would have to eat 5 to 15 kg (11 to 13 pounds) of contaminated seafood in a short period of time (biological half-life of barium is less than 24 hours) to be at risk. This event is highly unlikely (USEPA 1994).

Organic mercury is readily taken up by marine biota and accumulates in the liver and kidney (Hamer 1986). Mercury accumulation by pilot whales can be high enough to pose a health risk to human inhabitants of the Faroe Islands (Andersen et al. 1987), and seal meat has been found to contain high levels of mercury (Botta et al. 1983). The potential for chromosome mutagenicity was high in Greenlandic Eskimos with a high proportion of seal meat in their diets, and seal meat consumption was positively correlated with human blood concentrations of mercury and cadmium (Wulf et al. 1986).

The body burden of metals in birds and animals from areas remote from major human activity (the Antarctic and the Canadian Arctic) is relatively high (Steinhagen-Schneider 1986, Easton and Farant 1982). The increases in metal body burdens of animals consumed by humans that are attributable to drilling fluid discharges are expected to be minor, because drilling fluid discharges are periodic and of small volume. However, incrementally small additions of heavy metals from diverse sources do increase the potential for bioaccumulation of metals through the food chain. Metal content of drilling fluids should, therefore, be minimized (USEPA 1994).

On the basis of qualitative comparisons made between Cook Inlet fish contaminant concentrations and Columbia River or FDA market basket sample results (USEPA 2002; USFDA 2000; USFDA 2003, as cited in USEPA Region 10 2003) in EPA's *Survey of Chemical Contaminants in Fish, Invertebrates and Plants Collected in the Vicinity of Tyonek, Seldovia, Port Graham, and Nanwalek—Cook Inlet, AK* (USEPA Region 10 2003), organochlorine pesticide (dieldrin, DDT, chlordane) and PAH concentrations were greater in either or both Columbia River or FDA market basket samples than in Cook Inlet fish samples. Mercury concentrations were also greater in most Columbia River or FDA market basket samples except for Cook Inlet chinook and sea bass samples, which had concentrations similar to or between the concentrations detected in Columbia River and the FDA market basket study. Cadmium concentrations were detected at levels less than 30 ppm, which is the high end of the Agency for Toxic Substances and Disease Registry (ATSDR) range of cadmium concentrations detected in edible meat or marine shellfish (ATSDR 1999, as cited by USEPA Region 10 2003). Hexachorobenzene was one contaminant that was detected in Cook Inlet chinook and sockeye samples in greater concentrations than those detected in Columbia River. Overall, with the exception of hexachlorobenzene concentrations in Cook Inlet chinook and sockeye samples, contaminants detected in Cook Inlet fish were less than or comparable to contaminants detected in regional or national studies.

5.3 Physical Effects of Discharge

Sanitary effluent from exploration, development, and production facilities must meet the effluent limitations for TSS (30 to 56 mg/L, depending on the treatment unit used) required in the proposed NPDES general permit.

Excess cement slurry may contain up to 200,000 mg/L of TSS (daily maximum). However, because this wastestream is intermittent and the volume is small (about 4,200 gallons per event), it is not predicted to cause adverse impacts to marine organisms (SAIC 2001).

Estimates of the annual suspended solids discharged from the municipalities (2.03 thousand tonnes), refinery (0.03 thousand tonnes), and drilling fluids and cuttings (0.93 thousand tonnes) in Cook Inlet are only a fraction of the suspended sediments (36,343 thousand tonnes) discharged by the Knik, Matanuska, and Susitna Rivers (Table 5). Estimates of the annual discharge of biochemical oxygen demand or organic wastes from municipalities (4.27 thousand tonnes), seafood processors (2.52-8.58 thousand tonnes), and produced waters (3.67 thousand tonnes) are all about the same order of magnitude (MMS 2003).

Table 5. Estimates of Selected River and Point Source Discharges into Cook Inlet for 1 Year

Discharge Source	Total discharges (million cubic meters)	Suspended sediments (tonnes)	BOD or organic wastes (tonnes)	Oil and grease (tonnes)	Settleable solids (tonnes)
Rivers	70,100	36,343,000	—	—	—
Knick, Matanuska, Susitna (Gold Creek)	54,820				
Susitna River (Gold Creek) (Minimum) (Maximum)	8,900 (5,000) (11,630)	3,370			
Ninilchik	1,080				
Municipalities					
Permitted discharge rates-MAL	67.6	6,264	7,443		
Anchorage-Point Woronzof-MAL	60.8	6,078	7,294		—

Table 5. Estimates of Selected River and Point Source Discharges into Cook Inlet for 1 Year (Continued)

Discharge Source	Total discharges (million cubic meters)	Suspended sediments (tonnes)	BOD or organic wastes (tonnes)	Oil and grease (tonnes)	Settleable solids (tonnes)
Anchorage-Point Woronzof-1993	41.4	2,032	4,268	889	
Seafood processing	—	—	2,520-8,580	—	—
Produced Waters	7.36	—	3,670	250	—
Drilling fluids and cuttings (11 wells/year)	—	930	—	—	8,351
Refinery	—	30	30	—	—

BOD = Biochemical oxygen demand; MAL = monthly average limitation.
Source: MMS 2003

Dilution rates as high as 1,000,000:1 may occur for drilling solids within a distance of 200 meters (0.13 square kilometers) of a platform with surface currents of 30-35 centimeters per second (about 0.6–0.7 knots) (National Research Council 1983). Tidal currents in lower Cook Inlet may have velocities of 102–153 centimeters per second (about 2–3 knots), or more. The currents associated with the Cook Inlet circulation regime, especially the strong tidal currents and the morphometry of the inlet produce considerable crosscurrents and turbulence in the water column during both ebb and flood tides. The cumulative effects of hydrodynamic processes suggest the water column in lower Cook Inlet generally is vertically well mixed. The similarities between the respective suspended particulate matter concentrations, salinities, and temperatures at the surface and near the bottom suggest not only vertical mixing but also show the cross-channel gradients that exist in the water column. These gradients indicate that dilution, rather than deposition, is the major process controlling suspended particulate matter concentrations in the central part of the inlet (MMS 2003).

Only part of the solids in the drilling fluids and cuttings discharged into Cook Inlet may accumulate on the seafloor near the discharge. The bottom currents in lower Cook Inlet are strong enough to prevent the deposition of sand-size and smaller particles (Sharma 1979; Hampton 1982). Regional sediments indicate sorting by present-day transporting currents (Hampton, et al. 1981). Silts and muds are moved southward to outermost Cook Inlet and Shelikof Strait (Sharma and Burrell 1970; Carlson et al. 1977; Hampton 1982; Boehm 2001).

The flow of Cook Inlet water generally is to the southwest. Discharged substances that are dissolved or remain in suspension generally would be transported out of Cook Inlet and into the Gulf of Alaska within about 10 months (Kinney et al. 1969, 1970). The density of any drilling fluids discharged into Cook Inlet should range within 1,000–2,000 parts per thousand wet weight. This is a typical density range for used drilling fluid. For example, Adams (1985) stated a range between 1,080 and 1,800 ppt and the National Research Council (1983) a range (for OCS wells) of 1,190–2,090 ppt (MMS 2003).

With a dilution rate of 10,000:1, the concentration of drilling fluid initially would be reduced to 0.10–0.20 ppt (100–200 ppm) within 100 meters of the discharge site; a dilution rate of 1,000,000:1 would reduce the concentrations to 0.001–0.002 ppt (1–2 ppm) within 200 meters of the discharge site. Rapid settling of the heavier particles would result in greater reductions in the concentrations of the drilling fluids inside 100–200 meters from discharge than were estimated by using only the dilution factors. The concentration of suspended particulate matter in the water column of lower Cook Inlet ranges from 1–50 ppm. Thus, within about 100–200 meters of the discharge site, the concentration of particulate matter in the fluids and cuttings discharged into the water column is expected to be reduced to levels comparable to the levels of naturally occurring suspended-particulate matter (MMS 2003).

Therefore, no physical effects of the discharges from exploration, development, and production facilities are predicted.

5.4 SUMMARY

5.4.1 Lower Trophic Level Organisms

Routine, anticipated activities during exploration, development, and production in Cook Inlet probably would not have measurable effects on local populations of lower trophic-level organisms (MMS 2003).

During the hypothetical 5-year term covered under the proposed NPDES general permit, 11 wells would be drilled each year in Cook Inlet. Permitted discharges would include an estimated 3,690 tonnes (metric dry weight) of drilling fluids, 5,590 tonnes of drill cuttings, and 930 tonnes (metric dry weight) of suspended solids during a 5-year period. In Section 5.3 of this ODCE, it is noted that these amounts of material are a fraction of the particulate matter that rivers discharge daily into Cook Inlet. Discharges would become diluted rapidly as high as 1,000,000:1 with a distance of 200 meters (656 feet) of a platform, and there would be no effect on planktonic organisms, such as shrimp (National Research Council 1983). The drilling fluids and cuttings that accumulate on the seafloor in relatively shallow water might affect some benthic organisms for a short period close to the discharge point (MMS 1995). This assessment confirms the conclusion of the previous one that the effect probably would be sublethal for adults and might be lethal for immature stages within 1,000 meters of platforms that were actively discharging (i.e., for a few months or about a generation for typical benthic organisms) drilling fluids and cuttings. This assessment also confirms the conclusion in the water quality section that mixing in the water column would reduce the toxicity of drilling fluids to levels that would not be harmful to organisms in the water column. If drilling fluids and cuttings were not discharged during exploration, this local effect would not occur (MMS 2003).

In summary, the routine activities associated with exploration in upper Cook Inlet have not had a documented effect on lower trophic-level organisms. It is expected that the routine activities associated with exploration, development, and production would be similar, and no measurable effects on the local populations are expected from these routine activities (MMS 2003).

5.4.2 Fish

Fisheries resources (i.e., pelagic finfish, ground finfish, and shellfish) in the lower Cook Inlet area are described in Section 6. MMS performed an analysis on population-level impacts; its definition of a population is defined as a group of organisms of one species occupying a defined area (the central Gulf of Alaska encompassing the South Alaskan Peninsula, Kodiak Archipelago, Shelikof Strait, Cook Inlet, and Prince William Sound) and usually isolated to some degree from other similar groups. Routine activities associated with this alternative that may adversely affect fisheries resources include permitted drilling discharges. It is not expected that the various effects to fisheries resources, taken altogether, would cause population-level changes in the central Gulf of Alaska (MMS 2003).

The effects of exploration- and production-related activities on fisheries resources are expected to be essentially the same. Although there may be minor differences in the frequency or type of activities between exploration and production, those differences would not make a measurable difference on fisheries resources (MMS 2003).

5.4.3 Marine Birds

Platform discharges are not expected to have an effect on marine and coastal birds because of the high degree of dilution that would occur and the fact that bioaccumulation of associated pollutants is not expected (SAIC 2000).

5.4.3.1 Effects from Exploration

Routine operations associated with exploration that may have an effect on marine and coastal birds include well abandonment. Well abandonment could harm seabirds under certain circumstances. As part of the delineation well abandonment, the casings for these wells may be cut either mechanically or with explosives. The use of explosives raises the possibility of impacts to seabirds. Although no injuries to seabirds from well abandonment with explosives have been reported, brown pelicans, cormorants, gulls, and phalaropes have been killed or injured due to other sources of underwater explosions (Fitch and Young 1948). To be killed or injured during well abandonment with explosives, a bird would have to be submerged at the moment of the explosion. Although safety information is not available for birds, research on fish (Goertner 1981) and marine mammals (Young 1991) indicates that, for the amount of explosives used in well abandonment, a safe distance for these animals ranges from about 305–610 meters (1,000–2,000 feet), depending on the species. However, explosive charges probably would be set several feet below the seafloor, which would dampen the effect of the blast and reduce the area in which birds could be killed or injured. Because of the water depth of the wells and the damping effect of the position of the charges below the seafloor, a bird probably would have to be submerged directly above the well to be injured during well abandonment. The seabirds that might be injured are those that forage underwater. These include loons, shearwaters, scoters, and alcids. Many of these species remain relatively close to shore and would not be affected. Gulls might be attracted to the area by the dead fish that result from underwater explosions, but gulls feed on the surface and would not be affected. On the basis of the damping effect of the explosions being below the sea floor and the very low probability that seabirds would be both submerged at the moment of an explosion and in close enough proximity to be killed or injured, no impacts to marine and coastal birds from well abandonment would be expected (MMS 2003).

5.4.3.2 Effects from Development and Production

Routine operations associated with development and production that may have an effect on marine and coastal birds include: platform construction and operation and pipeline construction. However, most of these activities, including the vast majority of pipeline construction, will be conducted either well away (at least 5 kilometers [3 miles]) from any seabird colony or in ports where, at most, there are only a few nesting birds. These activities also can disturb birds at sea, but these effects would be limited to the immediate vicinity of the disturbance and would be very short in duration (for example, a few days to a few weeks).

Turbidity and disturbance of prey organisms in shallow nearshore waters from pipeline construction could have temporary effects on the availability of food sources of some sea ducks. This would be limited to the relatively small number of birds that forage along the shallow, nearshore portion of the pipeline corridor and would be short (i.e., one season) in duration. The greatest potential for impacts to birds would be at the site of the pipeline landfall. Impacts due to the construction of the pipeline landfall could include the temporary displacement of feeding and roosting birds from the immediate vicinity of the construction site. Impacts to nesting birds would be more severe and could include nest desertion, nest failure, lowered reproductive success, and reduced chick growth rates. These impacts likely would affect only birds nesting near (within .4 kilometer [one-quarter mile]) the construction site and would be short in nature (one season) (MMS 2003). A few birds nesting within .4 kilometer [one-quarter mile] of pipeline-landfall construction sites could suffer impacts during one breeding season (MMS 2003).

5.4.4 Marine Mammals

Seven species of nonendangered marine mammals numbering in the hundreds to thousands commonly occur year-round or seasonally in a portion of or throughout the Cook Inlet Planning Area and could be exposed to some OCS exploration, development, and production activities in Cook Inlet. These include the harbor seals and northern fur seals; Southcentral Alaska sea otters; killer, minke, and gray whales; and Dall's and harbor porpoises. Pollution and alteration of habitats could adversely affect these marine mammals found within Cook Inlet.

In the subsections below, it should be noted that the term *regional population or population within the region* is defined as the number of animals of a species that occur seasonally or year-round within the Cook Inlet Planning Area. A portion of a population in the region, for example, would be the number of harbor seals occurring in Kamishak Bay during the spring-summer breeding and molting periods (MMS 2003).

5.4.4.1 Effects From Exploration

Effects to nonendangered marine mammals would result from routine operations. The effects of exploration would occur primarily from routine operations (MMS 2003).

5.4.4.2 Effects of Development and Production

The effects of routine operations are expected to occur if the proposed leasing occurs and results in exploration, development, and production activities. Routine operations that may affect nonendangered marine mammals include disturbances from pipelines (MMS 2003).

If one 40-kilometer (25-mile) long gas offshore pipelines is laid per year in Cook Inlet, from the assumed one production platform in Cook Inlet during that time, this activity likely would alter a few square miles of benthic habitat very near, or within 1.6 or 3.2 kilometers (1 or 2 miles), of the pipelaying operation due to turbidity and removal of some prey organisms along the pipeline route. This would represent a short-term (one season) effect. The development of a pipeline terminal site might displace a small number (probably fewer than 10) of harbor seals near the site but would have no measurable effect on local populations (MMS 2003).

5.4.4.3 Effectiveness of Mitigating Measures

The stipulation on Protection of Biological Resources primarily concerns protection of benthic habitats that may be buried or covered by drill-platform installation. The amount of benthic habitats (probability 1 square kilometer or 0.386 square mile) is not expected to be of consequence to most nonendangered marine mammal populations, with the possible exception of gray whales that may feed in the area; thus, this stipulation is not expected to provide much protection to nonendangered marine mammals (MMS 2003).

5.4.5 Human Health

Increases in metal body burdens of animals consumed by humans that are attributable to drilling fluid discharges are expected to be minor. The proposed NPDES general permit will ensure increased compliance with produced water oil and grease ELG limits through the new produced water sheen monitoring requirement and it does not authorize new development or production facilities to discharge produced water. Also most contaminants detected in Cook Inlet fish are less than or comparable to contaminants detected in regional or national studies. Because of these reasons above and because additional permitted discharges from the existing and new platforms are minimally toxic, adverse human health effects are unlikely to result from Cook Inlet exploration and production discharges. Metal content of drilling fluids should be minimized through adherence to the effluent limitations in the proposed NPDES general permit to decrease the amount of heavy metals discharged to Cook Inlet (Tetra Tech 2006).

6.0 THREATENED AND ENDANGERED SPECIES

6.1 INTRODUCTION

Section 7(a)(2) of the ESA of 1973 requires federal agencies, in consultation with the agencies responsible for administering the ESA, the NMFS and the USFWS, to ensure that any action they authorize is not likely to jeopardize the continued existence and recovery of any species listed as threatened or endangered or result in the destruction or adverse modification of critical habitat. An endangered species is defined as a species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as a species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range (Tetra Tech 2006).

The threatened and endangered species listed below may be present near the proposed project.

- Chinook salmon (*Oncorhynchus tshawytscha*)
- Sockeye salmon (*Onchorhynchus nerka*)
- Short-tailed albatross (*Phoebastrai albatrus*)
- Steller's eider (*Polysticta stelleri*)
- Blue whale (*Baleaptera musculus*)
- Fin whale (*Balaenoptera physalus*)
- Humpback whale (*Megaptera novaengliae*)
- Northern Pacific right whale (*Eubalaena japonica*)
- Sei whale (*Balaenoptera borealis*)
- Sperm whale (*Physeter macrocephalus*)
- Steller sea lion (*Eumetopias jabatus*)
- Northern sea otter (*Enhydra lutris kenyoni*)

The Cook Inlet stock of beluga whales (*Delphinapterus leucas*) has been designated as depleted under the Marine Mammal Protection Act (MMPA) and area federal species of concern; therefore, beluga whales are also addressed in this section (NMFS 2000c).

A draft Biological Evaluation (BE) was prepared to assess the discharges from oil and gas exploration, development, and production facilities covered under the proposed NPDES general permit for Cook Inlet. The BE provides details about the geographic range and distribution, critical habitat, life history, and population trends and risks for each of the threatened and endangered species identified in this section of the ODCE (Tetra Tech 2006).

6.2 ABUNDANCE AND DISTRIBUTION OF THREATENED AND ENDANGERED SPECIES

6.2.1 Fish

6.2.1.1 Snake River Fall Chinook Salmon

Chinook salmon are anadromous and semelparous meaning that as adults, they migrate from a marine environment into the fresh water streams and rivers of their birth (anadromous) where they spawn and die (semelparous). Seasonal *runs* (i.e., spring, summer, fall, or winter) have been identified on the basis of when adult chinook salmon enter fresh water to begin their spawning migration (Tetra Tech 2006). Because genetic analyses indicate that fall-run chinook salmon in the Snake River are a distinct evolutionarily significant unit (ESU) from the spring/summer-run in the Snake River Basin (Waples et al. 1991), Snake River fall-run chinook salmon are considered separately. NMFS clarified the status of both ESUs as threatened in 1992 (NMFS 1992).

Two distinct races have evolved among chinook salmon. The *stream-type* race of chinook salmon, is found most commonly in headwater streams. Steam-type chinook salmon have a longer fresh water residency, and demonstrate extensive offshore migrations into the North Pacific before returning to their natal streams in the spring or summer months (NMFS 1998; Healy 1991).. The *ocean-type* chinook, including the Snake River fall-run chinook salmon ESU are commonly found in coastal streams in North America. Ocean-type chinook migrate to sea where they tend to spend their ocean life in coastal waters within about 1,000 kilometers (621 miles) from their natal river (NMFS 1998; Healy 1991). Ocean-type chinook salmon return to their natal streams or rivers in spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate (Tetra Tech 2006). The difference between these life history types is also physical, with both genetic and morphological foundations (NMFS 1998).

Almost all historical Snake River fall-run chinook salmon spawning habitat in the Snake River Basin has been blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries. The ESU's range has also been affected by agricultural water withdrawals, grazing, and vegetation management within the Columbia and Snake River Basins. The continued straying by nonnative hatchery fish into natural production areas is an additional source of risk (Tetra Tech 2006).

The historical population of Snake River fall-run chinook salmon is difficult to estimate. Irving and Bjornn (1981) estimated a population of 72,000 for the period of 1938 to 1949 that declined to 29,000 during the 1950s (Tetra Tech 2006). Numbers declined further following completion of the Hells Canyon Dam complex. The Snake River component of the fall-run chinook has been increasing during the past few years as a result of hatchery and supplementation efforts in the Snake and Clearwater River Basins. In 2002, more than 15,200 fall-run chinook were counted past the two lower dams on the Snake River, with about 12,400 counted above Lower Granite Dam. These adult returns are about triple the 10-year average at these Snake River projects (FPC 2003). For the Snake

River fall-run chinook salmon ESU, NOAA Fisheries estimates that the median population growth rate (lambda) over a base period from 1980 through 1998 ranges from 0.94 to 0.86. The decrease in growth rate reflects the increased effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure et al. 2000).

The critical habitat for the Snake River fall chinook salmon was listed on December 28, 1993 (NMFS 1993a) and modified on March 9, 1998, (NMFS 1998) to include the Deschutes River in Oregon. The designated critical habitat does not include any waters within the state of Alaska. It does include all river reaches accessible to chinook salmon in the Columbia River from The Dalles Dam upstream to the confluence with the Snake River in Washington (inclusive). Critical habitat in the Snake River includes its tributaries in Idaho, Oregon, and Washington (exclusive of the upper Grande Ronde River and the Wallowa River in Oregon, the Clearwater River above its confluence with Lolo Creek in Idaho, and the Salmon River upstream of its confluence with French Creek in Idaho). Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam (Tetra Tech 2006). Areas above specific dams or above longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for at least several hundred years) are excluded (NMFS 1998).

6.2.1.2 Snake River Spring/Summer Chinook Salmon

Recent trends in redd counts in major tributaries of the Snake River indicate that many subpopulations could be at critically low levels. Subpopulations in the Grande Ronde River, Middle Fork Salmon River, and Upper Salmon River Basins are at especially high risk. Both demographic and genetic risks would be of concern for such subpopulations, and in some cases, habitat may be so sparsely populated that adults have difficulty finding mates. NOAA Fisheries estimates that the median population growth rate (lambda) over a base period from 1980 through 1998 ranges from 0.96 to 0.80, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with the effectiveness of fish of wild origin (McClure et al. 2000). In 2002, the fish count at Lower Granite Dam was 75,025, more than double the 10-year average. Estimated hatchery chinook at Lower Granite Dam accounted for a minimum of 69.7 percent of the run (Tetra Tech 2006). The spring chinook count in the Snake River was at the all-time low of about 1,500 as recently as 1995, but in 2001 and 2002, both hatchery and wild/natural returns to the Snake River increased (FPC 2003).

The critical habitat for the Snake River spring/summer chinook salmon was listed in 1993 (NMFS 1993a). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, and all tributaries of the Snake and Salmon Rivers (except the Clearwater River) presently or historically accessible to Snake River spring/summer chinook salmon (except reaches above impassable natural falls and Hells Canyon Dam) (Tetra Tech 2006).

6.2.1.3 Sockeye Salmon

Snake River sockeye salmon returns to Redfish Lake since at least 1985, when the Idaho Department of Fish and Game began operating a temporary weir below the lake, have been extremely small (1 to 29 adults counted per year). Snake River sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by Snake River sockeye salmon. NMFS proposed an interim recovery level of 2,000 adult Snake River sockeye salmon in Redfish Lake and two other lakes in the Snake River Basin (NMFS 1995). Because only 16 wild and 264 hatchery-produced adult sockeye returned to the Stanley River Basin between 1990 and 2000, NMFS considers the risk of extinction of this ESU to be very high (Tetra Tech 2006). In 2002, 52 adult sockeye were counted at Lower Granite Dam (FPC 2003). As of September 23, 2003, 12 sockeye salmon have been counted at Lower Granite Dam on the Snake River (USACE 2003).

Historically, the largest numbers of Snake River sockeye salmon returned to headwaters of the Payette River, where 75,000 were taken one year by a single fishing operation in Big Payette Lake. During the early 1880s, returns of Snake River sockeye salmon to the headwaters of the Grande Ronde river in Oregon (Walleye Lake) were estimated between 24,000 and 30,000 at a minimum (Cramer 1990). During the 1950s and 1960s, adult returns to Redfish Lake numbered more than 4,000 fish (Tetra Tech 2006).

The critical habitat for the Snake River sockeye salmon was designated on December 28, 1993 (NMFS 1993a). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks) (Tetra Tech 2006).

6.2.2 Birds

6.2.2.1 Short-tailed Albatross (Phoebastrai albatross)

The short-tailed albatross was listed as endangered under the ESA in waters of the United States on July 30, 2000. This species once ranged throughout most of the North Pacific Ocean and Bering Sea with known nesting colonies on several islands within the territorial waters of Japan and Taiwan (Tetra Tech 2006). Other undocumented nesting colonies may also have existed in areas under U.S. jurisdiction on Midway Atoll in the Aleutian Islands; however, the evidence for breeding on the Alaskan Aleutian Islands is based on scant evidence considered highly unlikely (USFWS 2000a).

Breeding colonies of the short-tailed albatross are currently known on two islands in the western North Pacific and East China Sea. The marine range within U.S. territorial waters includes Alaska's coastal shelf break areas and the marine waters of Hawaii for foraging. The extent to which the birds use open ocean areas of the Gulf of Alaska, North Pacific Ocean, and Bering Sea is unknown (USFWS 2000a). Observations by the USFWS (Terry Antrobus, Anchorage, personal communication cited in USFWS 2000a) suggest that short-tailed albatross frequent nearshore and coastal waters, with "many" birds being sighted within 10 kilometers (6 miles) of shore, and fewer birds ("several") observed within 5 kilometers (3 miles) of shore. However, sighting data do not indicate that either the Cook Inlet or Shelikof Strait are part of the typical range of this species (MMS 2003).

Currently, breeding colonies are limited to two Japanese Islands of Torishima and Minami-kojima (USFWS 2000a). Birds arrive at the Torishima breeding colony in October and initiate breeding and egg-laying, which continue through late November. The chicks hatch in late December and January and are close to being full grown by late May or early June at which time the adults begin to abandon the breeding colony and return to sea. The chicks fledge after the departure of the breeding adults and depart the colony by mid-July. Non-breeders and failed breeders disperse from the breeding colony in late winter through spring (USFWS 2000a). The specific geographical and seasonal distribution patterns of the birds, once they depart from the breeding colony, are not well understood (Tetra Tech 2006). The birds are reported to be long-lived and slow to mature, with an average age at first breeding of 6 years old (USFWS 2000a).

The total population of short-tailed albatross was estimated to be 1,200 birds in 2000 (USFWS 2000a). Demographic information provided by USFWS (2000a) indicates that the breeding population on the island of Torishima is growing at a "fairly rapid rate," with an annual population growth rate of 7.8 percent. No information is available for the other breeding colony located on the island of Minamikojima (Tetra Tech 2006).

No critical habitat has been designated for short-tailed albatross (Tetra Tech 2006). The USFWS has determined that the designation of critical habitat for this species is not prudent because it would "not be beneficial to the species" (65 FR 46643, July 31, 2000). USFWS concluded that the designation of critical habitat for potential and actual breeding areas within the U.S. areas of jurisdiction on the Midway Atoll National Wildlife Refuge would not provide additional benefit or protection over that conferred through the jeopardy standard of section 7 of the ESA. With regard to the designation of critical habitat for foraging in the waters of the United States, USFWS concluded there is no information available to support a conclusion that any specific marine habitat areas are uniquely important (USFWS 2000a).

6.2.2.2 Steller's Eider (Polysticta stelleri)

The Alaskan breeding populations of Steller's eider were listed as threatened under the ESA on June 11, 1997 (Tetra Tech 2006). Two breeding populations in Arctic Russia are not part of the ESA listing in the United States and are not addressed in this section. The historical breeding range of the Alaskan breeding population of Steller's eider is unclear; it may have extended discontinuously from the eastern Aleutian Islands to the western and northern Alaska coasts, possibly as far east as the Canadian border (USFWS 2001). In western Alaska, historical (pre-1970) data suggests that the birds formerly nested on the Yukon-Kuskokwim River Delta (Y-K Delta) and at least occasionally at other western Alaska sites, including the Seward Peninsula, St. Lawrence Island, and possibly the eastern Aleutian Islands and Alaska Peninsula (USFWS 2002).

In recent times, breeding has occurred in two general areas outside of the NPDES general permit area. These areas are the Arctic Coastal Plain on the Alaskan North Slope and on the Y-K Delta in western Alaska (USFWS 2001). The Arctic Coastal Plain area, particularly the area surrounding Barrow, is extremely important to nesting Steller's eiders (USFWS 2002). Aerial surveys conducted 1999–2002 in a 2,757 km^2 area from Barrow south to Meade River recorded between 2 to over 100 breeding pairs for a maximum density of 0.08 birds per square kilometer (Tetra Tech 2006). The Y-K Delta is currently of much lesser importance; only seven nests were found on the Y-K Delta from 1994 to 2002 (USFWS 2002).

After breeding, Steller's eiders move to marine waters where they molt, and individuals remain flightless for about 3 weeks. The birds, which presumably consist of members of both Alaskan and Russian populations, primarily molt outside of the NPDES general permit area along the north side of the Alaska Peninsula, in Izembek Lagoon, Nelson Lagoon, Port Heiden, and Seal Islands (USFWS 2002). After molting, many Steller's eiders disperse to the Aleutian Islands, the south side of the Alaska Peninsula, Kodiak Island, and as far east as Cook Inlet (Tetra Tech 2006). Wintering birds usually occur in waters less than 10 meters (30 feet) deep and are, therefore, usually found within 400 meters (400 yards) of shore except where shallows extend further offshore in bays and lagoons (USFWS 2002).

The winter range from the Kodiak Island east to lower Cook Inlet overlaps the geographical area of the NPDES general permit. Birds from Alaska and Russian breeding populations intermix on the wintering grounds. It is not known what percentage of the wintering birds that overwinter in areas within or near the NPDES permit area are members of the ESA-listed population (Alaskan breeding population) versus the non-ESA-listed Russian breeding population (Tetra Tech 2006). According to the USFWS, about 4.2 percent of the Steller's eider in or near the Cook Inlet area are assumed to be from the Alaskan breeding population (MMS 2003).

Determining the population trends for Steller's eider is difficult (USFWS 2000c). Counts conducted in 1992 indicated that at least 138,000 birds wintered in southwest Alaska; although the proportion belonging to the Alaska-breeding population versus those from Russian-breeding populations is uncertain (USFWS 2002). It appears that the breeding range in Alaska has substantially contracted, with the species disappearing from much of its historical range in western Alaska (USFWS 2000c). The size of the breeding population on the Alaskan North Slope varies considerably among years and it is not known whether the population is currently declining, stable, or improving (USFWS 2000c).

The designated critical habitat for the Steller's eider includes five units along the Bering Sea and north side of the Alaskan Peninsula (Tetra Tech 2006). These are the Y-K Delta, Kuskokwim Shoals, Seal Islands, Nelson Lagoon, and Izembek Lagoon (USFWS 2001). Within these areas, the primary habitat components that are essential include areas to fulfill the biological needs of feeding, roosting, molting, and wintering. Important habitats include the vegetated intertidal zone and marine waters up to 9 meters (30 feet) and the underlying substrate and benthic community, associated interbrate fauna, and where present, eelgrass beds and associated biota (USFWS 2001).

No critical habitat is designated within the geographical within the geographical area of the proposed NPDES general permit for oil and gas exploration, development, and production facilities in Cook Inlet, Alaska (Tetra Tech 2006).

6.2.3 Marine Mammals

6.2.3.1 Blue Whale (Baleaptera musculus)

The blue whale was listed as endangered under the ESA on June 2, 1970. Blue whales are found in all of the world's oceans from the Arctic to the Antarctic. In the North Pacific, they rarely enter the Bering Sea and are only seldom seen as far north as the Chukchi Sea (ADFG 1994a). In the eastern North Pacific, they winter off southern and Baja California; during the spring and summer, they are found from central California northward through the Gulf of Alaska (Tetra Tech 2006). Historical areas of concentration in Alaska include the eastern Gulf of Alaska and the eastern and far western Aleutians (ADFG 1994a).

Blue whales are believed to migrate away from coastlines and feed preferentially in deeper offshore waters (Gregr and Trites 2001; Mizroch et al. 1984). They are seldom seen in nearshore Alaska waters (ADFG 1994a). These preferences make it highly unlikely that blue whales would frequent Cook Inlet waters within the area of coverage of the proposed NPDES general permit (Tetra Tech 2006).

Blue whales are estimated to reach sexual maturity between 5 and 10 years of age, and may live as long as 70 to 80 years (Environment Canada 2004b). Upon reaching sexual maturity, females bear a single calf every 2 to 3 years (ADFG 1994a). Like many other species of baleen whales, blue whales migrate from low-latitude wintering areas to high-latitude summer feeding grounds (Tetra Tech 2006).

Blue whales appear to practice more selective behavior in feeding than other rorquals (those baleen whales that possess external throat grooves during gulp-feeding) and specialize in plankton feeding, particularly swarming euphausids (krill) in the Antarctic (Tetra Tech 2006). In the North Pacific, the species *Euphausia pacifica* and *Thysanoessa spinifera* are the main foods of blue whales (ADFG 1994a).

The pre-whaling abundance of blue whales in the North Pacific has been estimated at 4,900 to 6,000 animals and is now to 1,200 to 1,700 animals (ADFG 1994a). There have been very few sighting of blue whales in Alaskan waters (Tetra Tech 2006). The first confirmed blue whale sighting in 30 years was observed by NOAA scientists on July 15, 2004, 100 nautical miles southeast of Prince William Sound (Joling 2004).

No critical habitat has been designated for the blue whale (Tetra Tech 2006).

6.2.3.2 Fin Whale (Balaenoptera physalus)

The fin whale was listed as endangered under the ESA on June 2, 1970. In the North Pacific Ocean, fin whales can be found from above the Arctic Circle to lower latitudes of approximately 20°N (Leatherwood et al. 1982). Fin whales along the Pacific coast of North America have been reported during the summer months from the Bering Sea to as far south as central Baja California (Tetra Tech 2006); three stocks are recognized: Alaska (Northeast Pacific), California/Washington/Oregon, and Hawaii (Angliss and Lodge 2003; NMFS 2003b).

Fin whales are believed to feed preferentially mainly in offshore waters, with preferred habitat encompassing a large area that includes the continental shelf break and offshore waters (Gregr and Trites 2001). They are seldom seen in inshore coastal waters. Fin whales regularly inhabit areas near NPDES permit coverage including Shelikof Strait, bays along Kodiak Island (especially Uganik and Uyak bays on the wet side), and the Gulf of Alaska. Some or all of these areas are feeding areas for fin whale (Tetra Tech 2006). Sighting data suggest that the distribution and abundance of fin whales in these areas vary seasonally, but there is documented use in the vicinity of Kodiak Island every month of the year except December and January (MMS 2003).

Fin whales tend to be more social than other rorquals, gathering in pods of 2-7 whales or more. Sexual maturity occurs at ages of 6–10 years in males and 7–years in females, and may live as long as 90 years of age (OBIS 2005). Reproductive activity occurs in winter, when whales have migrated to warmer waters. Females can mate every 2 to 3 years (Tetra Tech 2006).

Fin whales eat a variety of fish and zooplankton species including capelin, sandlance, herring, and euphausids (krill) (OBIS 2005).

The pre-whaling abundance of fin whales in the North Pacific has been estimated at 42,000 to 45,000 animals; estimates in the early 1970s range from 14,620 to 18,630 whales (Ohsumi and Wada 1974). There have been very few sightings of fin whales in Alaska waters (Tetra Tech 2006). A survey conducted in August 1994 covering 2,050 nautical miles of track line south of the Aleutian Islands encountered only 4 fin whale groups (NMFS 2003b).

No critical habitat has been designated for the fin whale (Tetra Tech 2006).

6.2.3.3 Humpback Whale (Megaptera novaengliae)

The humpback whale was listed as endangered under the ESA on June 2, 1970. The humpback whale is distributed worldwide in all ocean basins, although it is less common in Arctic waters. Currently there are four recognized stocks of humpback whales in U.S. waters based on geographically distinct winter ranges (NMFS 2005b): Gulf of Maine stock, eastern North Pacific stock, central North Pacific stock, and the western North Pacific stock. The central North Pacific stock includes animals found in Alaskan waters. In Alaskan waters, most humpbacks tend to concentrate in southeast animals found in Alaskan waters. In Alaskan waters, most humpbacks tend to concentrate in southeast

Alaska, Prince William Sound, the area near Kodiak and Barren Islands, the area between the Semidi and Shumagin Islands, eastern Aleutian Islands, and the southern Bering Sea (ADFG 1994b). In inside waters off southeastern Alaska (i.e., Glacier Bay and Frederick Sound) photo-identification studies summarized by Perry et al. (1999) appear to show that humpback whales use discrete, geographically isolated feeding areas that individual whales return to year after year. These studies find little documented exchange in individual animals between Prince William Sound areas and the Kodiak Island area, and between the Kodiak Island area and southeast Alaska feeding areas, suggesting that while movement among these areas may occur, it is reasonably uncommon (Tetra Tech 2006).

Although humpback whales can be observed year-round in Alaska, most animals migrate during the fall to temperate tropical wintering areas where they breed and calve (Tetra Tech 2006). Most whales that spend the summer to Alaskan waters are thought to migrate to winter in waters near Hawaii (ADFG 1994b; Perry et al. 1999). In the summer, humpback whales regularly are present and feeding in areas near and within the Cook Inlet lease-sale area, including Shelikof Strait, bays of Kodiak Island, and the Barren Islands, in addition to the Gulf of Alaska adjacent to the southeast side of Kodiak Island (especially Albatross Banks), the south sides of the Kenai and Alaska peninsulas, and south of the Aleutian Islands. There is some evidence of a discrete feeding aggregation of humpbacks in the Kodiak Island region. Humpbacks also may be present in some of these areas throughout the autumn. Within the proposed lease-sale area, large numbers of humpbacks have been observed in late spring and early summer feeding near the Barren Islands. Humpbacks have also been observed feeding near the Kenai Peninsula north and east of Elizabeth Island (MMS 2003).

Humpback whale feed preferentially over continental shelf waters (Gregr and Trites 2001) and are often observed relatively close to shore, including major coastal embayments and channels (NMFS 2005b).

Humpback whales are seasonal migrants. The whales mate and give birth while in wintering areas outside of Alaskan waters (Tetra Tech 2006). Sexual maturity occurs at age 4–6 years, with mature females giving birth every 2–3 years (ADFG 1994b). During spring, the whales migrate back to feeding areas in Alaskan waters, where they spend the summer (ADFG 1994b; Perry et al 1999).

Humpback whales use a variety of feeding behaviors to catch food including underwater exhalation of columns of bubbles that concentrate prey, feeding in formation, herding of prey, and lunge feeding (ADFG 1994b). On the basis of their diet, humpbacks have been classified as generalists (Perry et al. 1999). They have been known to prey upon euphausids (krill), copepods, juvenile salmonids (*Oncorhynchus spp.*), Arctic cod (*Boreogadus saida*), capelin (*Mallotus villosus*), Pacific herring (*Clupea harengus pallasi*), sand lance (*Ammodytes hexapterus*), walleye pollock (*Theragra chalcogramma*), pollock (*Pollachius virens*), pteropods; and some cephalopods (Tetra Tech 2006). On Alaska feeding grounds, humpback whales feed primarily on capelin, juvenile walleye pollock, sand lance, Pacific herring, and krill (NMFS 2003c; Perry et al. 1999).

The pre-whaling abundance of humpback whales in the North Pacific has been estimated to be approximately 15,000 animals (ADFG 1994b). The current total estimated abundance of the Central North Pacific stock of humpback whales is 4,005 individuals (NMFS 2005b). NMFS (2005b) reports abundance within known feeding areas in Alaska as southeast Alaska (961 whales), Kodiak Island area (651 whales), and Prince William Sound (149 whales). At least some portions of this stock have increased in abundance between the early 1800s and 2000 (Tetra Tech 2006). The rate of population increase in southeast Alaska may have recently declined, which may indicate the stock is approaching its carrying capacity (NMFS 2005b).

No critical habitat has been designated for the humpback whale anywhere throughout their range (Tetra Tech 2006).

6.2.3.4 North Pacific Right Whale (Eubalaena japonica)

The northern right whale (*Balaena glacialis*) was listed as endangered under the ESA on June 2, 1970. On April 10, 2003, the NMFS published a final rule (NMFS 2003a) that split the endangered northern right whale into two endangered species: North Atlantic right whale (*Eubalaena glacialis*) and North Pacific right whale (*Eubalaena japonica*) (Tetra Tech 2006). This section discusses the North Pacific right whale.

The North Pacific stock of northern right whale has historically occurred across the North Pacific, north of 35°N latitude, with concentrations of whales occurring in the Gulf of Alaska, eastern Aleutian Islands, south-central Bering Sea, Sea of Okhotsk, and the Sea of Japan (NMFS 2001).

Two populations of North Pacific right whale are thought to exist, one in the western North Pacific off Russia and the other in the eastern North Pacific off Alaska (MMC 2002). The distribution and status of neither population is well understood. The eastern population is more severely depleted than the western population, with the population thought to number in the tens of individuals versus hundreds for the western population (MMC 2002; NMFS 2005a). Between 1900 and 1994, there have been only 29 reliable sightings of right whales in the eastern North Pacific (Tetra Tech 2006). Since that time, between 4 and 13 individuals have been sighted each year; all these sightings have occurred in a 60 by 100 nautical mile area about 200 nautical miles north of Unimak Pass in the southeastern Bering Sea (CBD 2000; MMC 2002; NMFS 2002a).

Because the North Pacific eastern population is so small and infrequently sighted, little is known about their range and movements (Tetra Tech 2006). The whales are thought to move northward to high latitudes in the spring, summer in the Bering Sea and Gulf of Alaska, and move southward in the fall and winter possibly as far south as Baja, California (CBD 2000; NMFS 2002a).
Historically, right whales often were observed in coastal waters where their slow speed and tendency to float after death resulted in their near-decimation by whalers in the 1800s. Recent whale sightings have all occurred within the shallower waters of the continental shelf (CBD 2000). No information currently exists regarding the presence of this species in Cook Inlet, Alaska (Tetra Tech 2006).

The pre-exploitation size of the population of North Pacific right whales has been estimated as likely exceeding 10,000 animals (67 FR 7660, February 20. 2002) to 19,000 animals (CBD 2000). The current population is thought to be very small, perhaps in the tens of animals (Tetra Tech 2006). No sightings of a cow with a calf have been confirmed since 1900 (NMFS 2002b).

Among baleen whales, right whales appear to have the most specialized feeding strategy (Tetra Tech 2006). Studies conducted in the North Atlantic suggest that right whales require high densities of copepods concentrated in surface waters for effective feeding; the feeding requirements of an adult whale are estimated to be at least 4.07 x 105 Kcal/day (CBD 2000). The feeding preferences of North Pacific right whales have not been determined; however, the NMFS has noted that these whales probably feed almost exclusively on calanoid copepods, a component of zooplankton (NMFS 2002b).

On June 3, 1994, the NMFS designated critical habitat for the species of northern right whale (NMFS 1994a), which as of April 10, 2003, became referred to as the North Atlantic right whale (NMFS 2003a). The three areas designated as critical habitat are in the North Atlantic Ocean off the eastern United States. NMFS determined at the time that insufficient information was available to consider critical habitat designation for other stocks of northern right whale, including whales residing in the North Pacific (Tetra Tech 2006).

On October 4, 2000, the Center for Biological Diversity petitioned the NMFS to designate a portion of the southeastern Bering Sea as critical habitat for the North Pacific right whale on the basis of annual sightings of whales in the area that suggests the area is a summer feeding ground for this severely depleted population (CBD 2000). On July 11, 2001, the Marine Mammal Commission responded to this request by recommending that NMFS proceed with designating the area as critical habitat and modify the boundaries as future data about future population distribution becomes available (MMC 2002). However, on February 20, 2002, NMFS published notice that the Service had determined that the petitioned action to designate critical habitat was not warranted (NMFS 2002b) noting that because the essential biological requirements of the population in the North Pacific Ocean are not sufficiently understood, the extent of critical habitat cannot be determined. No critical habitat has been designated for the Northern Pacific right whale (Tetra Tech 2006).

6.2.3.5 Sei Whale (Balaenoptera borealis)

The sei whale was listed as endangered under the ESA on June 2, 1970. Sei whales have historically occurred in all oceans of the world, migrating from low-latitude wintering areas to high-latitude summer feeding grounds (Fisheries and Oceans Canada 2005). In the eastern North Pacific, sei whales are common in the southwest Bering Sea to the Gulf of Alaska (Tetra Tech 2006), and offshore in a broad arc about 40°N and 55°N (Environment Canada 2004a; WWF 2005).

The sei whale prefers deeper offshore waters, with preferred habitat tending to occur in offshore areas that encompass the continental shelf break (Gregr and Trites 2001). Commercial whaling catch records off British Columbia indicate that less than 0.5 percent of sei whales were caught in waters over the continental shelf (Environment Canada 2004a). These preferences make it unlikely that sei whales would frequent Cook Inlet waters within the geographic area covered by the proposed NPDES general permit (Tetra Tech 2006).

Sei whales reach sexual maturity between 5 and 15 years of age and may live as long as 60 years. Like many other species of baleen whales, sei whales migrate from low-latitude wintering areas to high-latitude summer feeding grounds. Catch records suggest that whale migrations are segregated according to length (age), sex, and reproductive status (Tetra Tech 2006). Pregnant females appear to lead the migration to feeding grounds, while the youngest animals arrive last and depart first (Environment Canada 2004a). Sei whales feed primarily on copepods, followed by squid, euphasids, and small pelagic fish (Trites and Heise 2005).

The pre-whaling abundance of sei whales in the North Pacific has been estimated to range from 42,000-62,000 animals (Ohsumi and Wada 1974; Tillman 1977). There are no current data on trends in sei whale abundance in the eastern North Pacific waters. A fact sheet prepared by NMFS (2000b) on the eastern North Pacific stock of sei whale suggest that the population is expected to have grown since being given protected status under the Marine Mammal Protection Act in 1976; however, continued unauthorized take, incidental ship strikes, and fill net mortality makes this uncertain (Tetra Tech 2006).

No critical habitat has been designated for the sei whale (Tetra Tech 2006).

6.2.3.6 Sperm Whale (Physeter macrocephalus)

The sperm whale was listed as endangered under the ESA on June 2, 1970. Sperm whales inhabit all ocean basins, from equatorial to polar waters. Their distribution generally varies by gender and the age composition of groups, and is influenced by prey availability and oceanic conditions (Perry et al. 1999). In the North Pacific, sperm whales are distributed widely, with the northernmost boundary extending from Cape Navarin (62°N) to the Pribilof Islands (Angliss and Lodge 2003). Mature females, calves and immature whales of both sexes in the North Pacific are found in social groups, and remain in tropical and temperate waters year round from the equator to approximately 45°N latitude (Angliss and Lodges 2003; Perry et al 1999). Males lead a mostly solitary life after reaching sexual maturity between 9 and 20 years of age, and are thought to move north in the summer to feed in the Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands (Tetra Tech 2006). Research has revealed considerable east-west movement between Alaska and the western North Pacific (Japan and Bonin Islands), with little evidence of north-south movement in the eastern Pacific (Angliss and Lodge 2003; Perry et al 1999).

The habitat preferred by sperm whales differs among the sexes and age composition of individual whales (Tetra Tech 2006). The social groups composed of females, calves, and immature whales have a broader habitat distribution than males; they are generally restricted to waters with surface temperatures greater than 15°C and are rarely found in areas with water depths less than 200 to 1,000 meters (656 to 3,280 feet) (Gregr and Trites 2001; Reeves and Whitehead 1997). Males exhibit a tighter distribution over deeper waters along the continental shelf break, and are often found near steep drop-offs or other oceanographic features (e.g., offshore banks, submarine trenches and canyons, continental shelf edge), presumably because these areas have higher foraging potential (AKNHP 2005; Gregr and Trites 2001).

The distribution of sperm whales indicates that male sperm whales are the only sex that frequent Alaskan waters. Available evidence indicates that males are present offshore in the Gulf of Alaska during the summer, but they are very unlikely to be present in the permit coverage area in Cook Inlet (Tetra Tech 2006).

Sperm whales appear to be organized in a social system that consists of groups of 10–40 adult females plus their calves, which remain year-round in tropical and temperate waters (Tetra Tech 2006). Solitary males join these groups during the breeding season, which takes place in the middle of the summer (NMML 2004a). Males reach sexual maturity at 9–20 years of age (Perry et al 1999), but do not seem to take an actual part in breeding until their late 20s (ACS 2004). Female sperm whales reach sexual maturity at around 9 years of age and produce a calf approximately once every 5 years (NMFS 2005c).

Sperm whales feed primarily on medium-sized deep water squid, with the remaining portion of their diet composed of octopus, demersal and mesopelagic sharks, skates, and fish; feeding occurs all year-round, usually at depths below 122 meters (400 feet) (ACS 2004; AKNHP 2005; NMFS 2005c; NMML 2004a).

Pre-whaling abundance estimates of sperm whale in the North Pacific are considered unreliable and range from 472,000 to 1,260,000 animals (Angliss and Lodge 2003; Perry et al 1999; NMFS 2005c). The abundance of whales in the North Pacific in the 1970s was estimated to be 930,000 animals (Rice 1989). The current abundance of the North Pacific stock (Alaska) of sperm whale is unknown (NMFS 2005c).

No critical habitat has been designated for the sperm whale (Tetra Tech 2006).

6.2.3.7 Steller Sea Lion (Eumetopias jubatus)

The NMFS listed the Steller sea lion as threatened, by emergency interim rule, on April 5, 1990 (NMFS 1990a). The emergency rule listing, which had duration of 240 days, was followed by a final listing of the Steller sea lion as threatened on November 26, 1990 (NMFS 1990b). On May 5, 1997, the NMFS issued a final rule that reclassified Steller sea lions into two distinct population segments (NMFS 1997). The Steller sea lion population west of 144°W longitude (a line intersecting the Alaskan coastline near Cape Suckling) was reclassified as endangered; the sea lion population to the east of this line retained its ESA-listing status as threatened (Tetra Tech 2006).

The Steller sea lion is distributed around the North Pacific Ocean rim from northern Hokka, Japan along the western North Pacific northward through the Kuril Islands and Okhotsk Sea, then eastward through the Aleutian Islands and central Bering Sea, and southward along the eastern North Pacific to the Channel Islands, California (NMML 2004b). Two distinct populations (western and eastern) are thought to occur within this range, with the dividing line being designated as 144°W longitude (NMFS 1997).

There is designated critical habitat for the Steller sea lion and other habitat considered as critical habitat by the NMFS within the lease-sale area at Cape Douglas, the Barren Islands, and marine areas adjacent to the southwestern Kenai Peninsula, and at the extreme southern end of Cook Inlet (Tetra Tech 2006). There is additional critical habitat—including rookeries, haulouts, and marine foraging areas for the western population stock—in areas near the proposed lease-sale area, including Shelikof Strait, and areas along the southern side of the Alaska Peninsula (MMS 2003).

The breeding season for the Steller sea lion is from May to July, where the animals congregate at rookeries, the males defend territories, mating occurs, and the pups are born (Tetra Tech 2006). Nonreproductive animals congregate to rest at more than 200 haulout sites where little or no breeding occurs. Bulls become sexually mature between 3 and 8 years of age, but typically are not able to gain sufficient size and successfully defend territory within a rookery until 9–10 years of age. Females reach sexual maturity and mate at 4–6 years of age and typically bear a single pup each year. Sea lions continue to gather at both rookeries and haulout sites throughout the year, outside of the breeding season (NMML 2004b). Habitat types that typically serve as rookeries or haulouts include rock shelves, ledges, and slopes and boulder, cobble, gravel, and sand beaches. Seasonal movements occur generally from exposed areas in summer to protected areas in winter (ADFG 1994c).

When foraging in marine habitats, Steller sea lions typically occupy surface and mid-water ranges in coastal regions (Tetra Tech 2006). They are opportunistic predators and feed on a variety of fish [walleye pollock, Atka mackerel (*Pleurogrammus monopteryguius*), Pacific herring, capelin, sand lace, Pacific cod (*Gadus macrocephalus*), and salmon], and invertebrates (squid, octopus) (ADFG 1994c; NMML 2004b).

In 1980, the world population of Steller sea lions was estimated to be between 245,000 and 290,000 (Loughlin et al. 1992). The western population of Steller sea lions has declined at about 5.0 percent per year over the period of 1991-2000, while the eastern population has increased at about 1.7 percent per year (Loughlin and York 2000). According to recent survey data collected in 2003-2004, Fritz and Stinchcomb (2005) suggest that the decline of the western population within Alaskan territory may have abated in recent years, with an annual rate of increase estimated at 2.4 to 4.2 percent (Tetra Tech 2006).

In 1993, NMFS issued a final rule designating critical habitat for the Steller sea lion, including all U.S. rookeries, major haulouts in Alaska, horizontal and vertical buffer zones (5.5 kilometers) around these rookeries and haulouts, and three aquatic foraging areas in north Pacific waters, including Sequam Pass, southeastern Bering Sea shelf, and Shelikof Strait (NMFS 1993b). This final rule was amended on June 15, 1994, to change the name of one designated haulout site from Ledge Point to Gran Point and to correct the longitude and latitude of 12 haulout sites, including Gran Point (NMFS 1994b).

Critical habitat includes a terrestrial zone that extends 0.9 kilometers (3,000 feet) landward from the baseline or base point of each major rookery and major haulout in Alaska (Tetra Tech 2006). Critical habitat includes an air zone that extends 0.9 kilometers (3,000 feet) above the terrestrial zone of each major rookery and haulout area measured vertically from sea level. Critical habitat within the aquatic zone in the area east of 144°W longitude (ESA endangered population) extends 20 nautical miles (37 kilometers) seaward in state and federally managed waters from the baseline or base point of each rookery or major haulout area (NMFS 1993).

6.2.3.8 Northern Sea Otter (Enhydra lutris kenyoni)

The USFWS issued a final rule listing the southwest Alaska distinct population segment of the northern sea otter as threatened under the ESA on August 9, 2005 (USFWS 2005). The overall range of the sea otter extends from northern Japan to southern California. There are three recognized subspecies of *Enhydra lutris*. *E. lutris kenyoni*, referred to as the northern sea otter, has a range that extends from the Aleutian Islands in southwestern Alaska to the coast of the state of Washington (USFWS 2005).

Sea otters generally occur in shallow water areas near the shoreline where they forage in shallow water (Tetra Tech 2006). Visual observation of 1,251 dives by sea otters in southeast Alaska, indicates that foraging activities typically occur in water depths ranging from 2 to 30 meters (7 to 98 feet), although foraging at depths up to 100 meters (328 feet) was observed (Bodkin et al 2004).

Sea otter movements are influenced by local climatic conditions such as storm events, prevailing winds, and in some areas, tidal conditions (Tetra Tech 2006). They tend to move to protected or sheltered waters during storm events of high winds (USFWS 2005). The animals usually do not migrate and seldom travel unless an area has become overpopulated or food is scarce (ADFG 1994d).

The home ranges of sea otters in established populations are relatively small. Sexually mature females have home ranges of 8–16 kilometers (5–10 miles). Breeding males remain for all or part of the year within the bounds of their territory, which constitutes the length of coastline from 100 meters (328 feet) to 1 kilometers (0.6 miles) (Tetra Tech 2006). Male sea otters that do not hold territories may move greater distances between resting and foraging areas than territorial males (USFWS 2005).

Sea otters mate at all times of the year, and young may be born in any season; however, in Alaska, most pups are born in late spring (ADFG 1994d). Females typically give birth in the water, although they have been observed giving birth on shore (USFWS 2005). Male sea otters appear to reach sexual maturity at 5–6 years of age and have a lifespan of about 10–15 years (Tetra Tech 2006). Female sea otters reach sexual maturity at 3–4 years of age and have a lifespan of about 15–20 years (USFWS 2005). Sea otters are gregarious and may become concentrated in an area, sometimes resting in pods of fewer than 10 to more than 1,000 animals (ADFG 1994d).

The search for food is one of the most important daily activities of sea otters, as large amounts are required to sustain the animal in healthy condition (Tetra Tech 2006). Sea urchins, crabs, clams, mussels, octopus, other marine invertebrates, and fishes make up the normal diet of sea otters (ADFG 1994d).

Prior to commercial exploitation, the world population of sea otter in the North Pacific Ocean was estimated to be between 150,000–300,000 individuals (USFWS 2005). Over the next 170 years, sea otters were hunted to the brink of extinction first by Russian and later by American fur hunters (Tetra Tech 2006). Sea otters became protected under the International Fur Seal Treaty of 1911; at that time the entire population may have been reduced to 1,000–2,000 animals (USFWS 2005).

By the 1980s, sea otters in southwest Alaska had increased in abundance and recolonized much of their former range. The population in southwest Alaska is currently estimated at 41,865 animals (USFWS 2005); 15 percent (6,284 animals) of this total occur within the Kodiak Archipelago, which lies near the geographic area of the proposed NPDES general permit (Tetra Tech 2006).

No critical habitat has been designated for the northern sea otter (Tetra Tech 2006).

6.2.3.9 Beluga Whale (Delphinapterus leucas)

Beluga whales are one of the two members of the family Monodontidae and are divided into five stocks on the basis of mitochondrial DNA analyses: Cook Inlet, Bristol Bay, eastern Bearing Sea, eastern Chukchi Sea, and Beaufort Sea (NMFS 2003a). The Cook Inlet stock of beluga whales was placed on the ESA candidate list in 1991 (NMFS 1991). The stock was more recently determined to be depleted under the Marine Mammal Protection Act (NMFS 2000c).

NMFS stock assessment reports estimate the combined population of the five beluga whale stocks in U.S. waters at nearly 60,000 individuals (NMFS 2005d). NMFS reports that the population trends for the Beaufort Sea and Eastern Bering Sea stocks are unknown; these two stocks account for over 90 percent of the estimated population of beluga whales in U.S. waters (NMFS 2005d). The population of the Eastern Chukchi stock, consisting of 3,710 individuals, shows no evidence of decline, and NMFS considers the population of the Bristol Bay stock (1,619) to be stable to increasing (NMFS 2005d). From the range of numbers reported, NMFS estimates that the population in the mid-1980s was between 1,000 to 1,300 individuals (Tetra Tech 2006). Population trend analyses conducted on the Cook Inlet stock between June 1994 and June 1998 were constrained by the limited data available but showed a high probability that a 40 percent decline in the population had occurred during the time period (NMFS 2000d; NMFS 2005d).

NMFS included the Cook Inlet beluga whale stock on the candidate list of threatened and endangered species in 1991 (NMFS 1991). No further action was taken immediately following although NMFS received two petitions in 1999 to list the Cook Inlet stock under the ESA (NMFS 2000c) resulting in the Cook Inlet stock being designated as depleted under the MMPA (NMFS 2000d). Subsequent investigations assessed natural and human-induced sources of potential impacts that included:

- Habitat capacity and environmental change
- Strandings events
- Predation
- Subsistence harvest
- Commercial fishing
- Oil and gas development

The investigations concluded that subsistence harvests presented the most immediate threat to the stock. Although NMFS found that other potential sources of impact could have some negative effect on recovery, none were considered significant (NMFS 2000c). Population surveys since the imposition of mandatory and voluntary restrictions on subsistence harvests in 1999 show no clear trend and no indication that the population is increasing (NMFS 2005e). As a result, NMFS developed the *Draft Conservation Plan for the Cook Inlet Beluga Whale (Delphinapterus leucas)* in 2005 to establish goals and objectives that can be achieved cooperatively to promote the recovery of the Cook Inlet beluga whale population. The goals and objectives apply to a range of potential sources of impacts including those identified above as well as shoreline development, vessel traffic, and noise (Tetra Tech 2006).

Critical habitat is not applicable to this species because it is not designated under the ESA (Tetra Tech 2006).

6.3 EFFECTS OF PERMITTED DISCHARGES ON THREATENED AND ENDANGERED SPECIES

This section summarizes potential impacts on threatened and endangered species from discharges from oil and gas exploration, development, and production facilities in state and federal waters covered under the proposed NPDES general permit for Cook Inlet, Alaska. The discharges are described in Section 2.2. Potential impacts of these discharges on threatened and endangered species were evaluated as part of a Biological Evaluation (BE) prepared for the Cook Inlet proposed NPDES general permit (Tetra Tech 2006) in compliance with Section 7 of the ESA. Conclusions of the BE are summarized below.

6.3.1 Snake River Fall-Run Chinook Salmon and Snake River Spring/Summer-Run Chinook Salmon

Assuming the possibility that Snake River fall-run chinook salmon and Snake River spring/summer run chinook salmon may occur within the permit area, the potential for impacts is extremely low. Salmon are mobile and unlikely to spend substantial periods of time within discharge mixing zones; previous work has determined that exposure to discharged pollutant concentrations equal to Alaska water quality standards are not likely to adversely affect this species. The discharge of drilling fluids and cuttings could potentially be a source of localized impacts; however, those activities are limited to existing discharges. Existing discharges are found in the northern portion of Cook Inlet, where habitat values are poorer due to naturally high turbidity levels and strong currents. If Snake River fall-run salmon were to be exposed to facilities covered by the proposed NPDES general permit, it would more likely be the new source facilities that would occur in the better quality habitat in the southern portion of Cook Inlet. The proposed NPDES general permit prohibits the discharge of drilling fluids and cuttings from these facilities reducing the potential for even localized impacts (Tetra Tech 2006).

The discharges authorized under the proposed NPDES general permit are unlikely to adversely affect Snake River fall-run chinook salmon and the Snake River spring/summer run chinook salmon or their habitat in Cook Inlet. The issuance of the proposed NPDES general permit therefore is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.2 Snake River Sockeye Salmon

Data on the ocean distribution of Snake River sockeye salmon are limited due to the size of the population and difficulties with sampling methodology. Information available more broadly for Washington and British Columbia stocks indicate that they reach the Gulf of Alaska. Within the Gulf of Alaska, these stocks' northernmost distribution is limited to the area south and east of Kodiak Island (Burgner 1991). Because the Snake River sockeye ESU can be assumed to be distributed similarly to the other Washington and British Columbia, Cook Inlet is outside the known range of the Snake River sockeye ESU. The issuance of the proposed NPDES general permit therefore is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.3 Short-tailed Albatross

Cook Inlet waters are not part of the typical geographic range of the species. Discharges from oil and gas exploration, development, and production facilities will not have an affect on breeding or foraging activities to support fledgling chicks. Adult birds may occasionally occur within the proposed NPDES general permit's coverage area. Under the proposed NPDES general permit, existing facilities are allowed to discharge produced waters in the northern portion of Cook Inlet, but these discharge areas are far from the preferred pelagic habitat of the adult birds of this species. Considering the geographic distribution of the short-tailed albatross, the low probability that this species will use waters in close proximity to permitted activities, and the conclusion that permitted actions would have little effect on the bird's behavior, foraging ability, or prey species, it is concluded that the issuance of the proposed NPDES general permit may affect, but is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.4 Steller's Eider

Steller's eiders are not reported to nest in any locations within or near the proposed NPDES general permit's coverage area. Molting and winter habitat, however, is thought to extend throughout southern Cook Inlet, approximately as far north as Trading Bay (USFWS 2003). All the existing oil and gas production facilities are in northern Cook Inlet and, with the exception of the East Foreland facilities, appear not to fall within the mapped winter habitat. The birds would not be expected to occupy areas within the designated mixing zones because of their preference for nearshore, shallow foraging habitat. Exposure to discharge waters that comply with chronic water quality standards are not expected to adversely affect Steller's eiders. The potential impacts to Steller's eiders from the discharge of drilling fluids and cuttings authorized under the proposed NPDES general permit are expected to be insignificant. Any effects on the deposition of drilling fluids that could alter the benthic habitat and adversely affect shallow water mollusks and crustaceans that Steller eiders feed upon would extend over a very small fraction of the bird's available winter range and would not noticeably impact overall prey abundance and availability (Tetra Tech 2006).

The issuance of the proposed NPDES general permit may affect, but is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.5 Blue Whale

Available evidence indicates that blue whales are unlikely to inhabit Cook Inlet waters at any time of the year. While they are seasonally present in the Gulf of Alaska, they are typically offshore and relatively rare (MMS 2003). The issuance of the proposed NPDES general permit is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.6 Fin Whale

Fin whales are unlikely to spend substantial amounts of time within discharge mixing zones, and previous work has determined that exposure to discharged pollutant concentrations equal to the Alaska water quality standards are not likely to adversely affect this species (Tetra Tech 2006). The discharges authorized under the proposed NPDES general permit are unlikely to adversely affect fin whales or their habitat in Cook Inlet. The issuance of the proposed NPDES general permit is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.7 Humpback Whale

Humpback whales are unlikely to spend substantial amounts of time within discharge mixing zones, and previous work has determined that exposure to discharged pollutant concentrations equal to the Alaska water quality standards are not likely to adversely affect this species. Issuance of the proposed NPDES general permit is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.8 Northern Right Whale

There is no evidence that northern right whales ever inhabited Cook Inlet waters. These whales do occur in the Gulf of Alaska, and any impacts to this species would be significant given their extremely small population size. However, because this species is extremely rare in Alaskan waters and only occurs in waters well outside the action area, it is concluded that the issuance of the proposed NPDES general permit is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.9 Sei Whale

It is very unlikely that Sei whales would occur in any areas impacted by discharges authorized under the proposed NPDES general permit. The issuance of the proposed NPDES general permit is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.10 Sperm Whale

It is very unlikely that sperm whales would occur in any areas impacted by discharges authorized under the proposed NPDES general permit. The issuance of the proposed NPDES general permit is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.11 Northern Sea Otter

Drilling fluid discharges could adversely affect local otter populations that forage in the vicinity of these discharges by altering prey availability due to the burial of benthic organisms or changes in bottom habitat characteristics. Exposures to increased pollutant concentrations within designated mixing zones and exposure to discharged waters that comply with chronic water quality standards are not expected to adversely affect northern sea otters. Although the proposed NPDES general permit prohibits discharge of free oil, the oil and gas operations regulated under the permit do pose a potential risk to northern sea otters from oil spills. The issuance of the proposed NPDES general permit may affect, but is *not likely to adversely affect (NLAA)* this species (Tetra Tech 2006).

6.3.12 Steller Sea Lion

The Steller sea lion is the only ESA-listed species with designated critical habitat within the geographic area of coverage for the proposed NPDES general permit. Critical habitat occurs at Cape Douglas, the Barren Islands, and marine areas adjacent to the southwestern Kenai Peninsula (Tetra Tech 2006). There is additional critical habitat including rookeries, haulouts, and marinee foraging areas for the western population of sea lions in areas near the proposed NPDES general permit action area within the Shelikof Strait and areas along the southern side of the Alaska Peninsula (MMS 2003).

Drilling fluid discharges are unlikely to adversely impact the Steller sea lion because critical habitat restrictions do not allow discharges in the vicinity of Steller sea lions. Also, the rapid dilution and low toxicity of drilling fluids discharged in Cook Inlet imply that these discharges would not be likely to adversely affect pollock or other Steller sea lion prey (Tetra Tech 2006).

Exposure to increased pollutant concentrations within designated mixing zones and exposure to discharge water that comply with chronic water quality standards are not expected to adversely affect Steller sea lions. It is unlikely that this species will be adversely impacted by noise associated with oil and gas exploration, development, and production activities due to the critical habitat restrictions that prevent aircraft and vessels from operating near critical habitat (Tetra Tech 2006).

The discharges authorized under the proposed NPDES general permit are *not likely to adversely affect (NLAA)* the western population of Steller sea lions (Tetra Tech 2006).

6.4 DEPLETED STOCK ASSESSMENT FOR BELUGA WHALE

Beluga whales have been observed throughout Cook Inlet but are concentrated in the in tidal flats, river mouths, and estuaries in the northern portions of the inlet throughout the summer. The whales are thought to move to deeper waters in winter, ranging as far south as Chinitna Bay and Tuxedni Bay, although they have been observed in the Knik and Turnagin arms in February and March (NMFS 2005f). The draft conservation plan for the Cook Inlet beluga whale stock identifies the Knik and Turnagin arms, Chickaloon Bay, and at the mouths of rivers as the highest value and most sensitive habitat for the whales (NMFS 2005f). Proposed NPDES general permit activities would occur outside the high summer concentration areas in Type 1 and Type 2 habitats as identified in the draft conservation plan as a result of ADNR restrictions on the location of oil leases in the upper Cook Inlet and the proposed NPDES general permit's prohibition of activities within 4,000 meters of the mouth of a river, river delta, or coastal marsh. During winter, when beluga whales are distributed more widely throughout the inlet, the whales occur within the area covered by the proposed NPDES general permit (Tetra Tech 2006).

Drilling fluid discharges could adversely affect prey availability in the immediate vicinity of the discharges because of the burial of benthic organisms, or changes in bottom habitat characteristics. Such effects would be of limited size and duration. Exposure to increased pollutant concentrations within designated mixing zones are unlikely to cause adverse effects to beluga whales because of the whales' mobility and limited amount of time within spent within these areas. Exposure to discharge waters that comply with chronic water quality standards are not expected to adversely affect beluga whales (see Section 5.1.3.2) (Tetra Tech 2006).

The proposed NPDES general permit has been developed with consideration of the protection measures, including the avoidance of Type 1 and 2 habitats outlined in the NMFS draft conservation plan. The discharges authorized under the proposed NPDES general permit may affect individual beluga whales either directly or indirectly; however, they are not likely to contribute to a further decline of the Cook Inlet beluga whale stock or affect the recovery of the population as a whole (Tetra Tech 2006).

6.5 SUMMARY

The cumulative impact analysis summarized in the Cook Inlet proposed NPDES general permit BE (Tetra Tech 2006) considers the past and current lease sale activities; past oil and gas exploration and production; oil and gas discoveries that have a reasonable chance of being developed during the next 15 to 20 years; and speculative exploration and development of additional undiscovered resources (onshore and offshore) that could occur during the next 15 to 20 years. The results of this analysis indicate that discharges from production facilities and routine other discharges associated with oil production are not expected to have cumulative effects based on the modeling conducted for the permit reissuance. Therefore, no cumulative effects would be expected to threatened and endangered species.. Also, it was determined in the BE that there are no interdependent or interrelated actions expected as a result of the issuance of this proposed NPDES general permit.

On the basis of the Cook Inlet tidal flux, the anticipated volumes of wastewater discharge, and the contribution of the oil and gas exploration, development, and production to the cumulative loading of waste discharges in Cook Inlet, the Cook Inlet proposed NPDES general permit BE concluded that discharges from these facilities will likely have no adverse effects on the marine mammal and bird species described above or to critical habitat associated with these species.

7.0 COMMERCIAL, RECREATIONAL, AND SUBSISTENCE HARVEST

This section describes the commercial, recreational, and subsistence fisheries in Cook Inlet, and the potential impact of discharges from exploration, development, and production operations in the areas covered under the proposed NPDES general permit for Cook Inlet.

7.1 COMMERCIAL HARVESTS

Commercial fishing has long been a major economic sector for the Cook Inlet area. The Alaska Department of Fish and Game (ADFG) is responsible for management of the commercial fisheries in Alaska. Commercial fisheries in these waters include salmon, herring, groundfish (halibut, lincod, rockfish, sablefish, pollock, and Pacific cod), and shellfish (crab, shrimp, scallops, and clams) (MMS 2003).

The groundfish fishery in the Cook Inlet area is very limited and is estimated to have contributed less than 1 percent of the state's total value for groundfish for many years. The value of the halibut landed in the Central Region of Alaska (most coming from the Cook Inlet) was 26 percent of the state's total for halibut (MMS 2003).

Cook Inlet has supported commercial shellfish fisheries for red king, tanner, and Dungeness crabs; the weathervane scallop; hard-shell clams; razor clams; and shrimp. Due to low abundance levels in the Cook Inlet area, the fisheries for red king, tanner, and Dungeness crabs and for shrimp have been closed for some time. The fisheries for weathervane scallops and hard-shell and razor clams remain open in the Cook Inlet area (MMS 2003).

Pacific herring are harvested annually in Cook Inlet. They are mainly used for their roe and sac-roe-on-kelp, which is marketed in Pacific Rim countries. Harvests in the upper Cook Inlet area have averaged well under 400 tons a year (less than $200,000 ex-vessel value), which makes it one of the smallest herring fisheries in the state. Most of the herring fisheries in the northern Cook Inlet have been closed and since 1998. The ex-vessel value of the upper Cook Inlet herring fishery has dropped to less than $20,000 per year. From 1973 to 1998, ex-vessel values in the Kamishak Bay district have ranged from $70,000 to $9,300,000. The Kamishak Bay fishery was closed in 1999 due to low stock abundance (MMS 2003).

All five species of Pacific salmon are harvested commercially (as well as for subsistence and sport) in Cook Inlet. Cook Inlet fisheries use purse seines, drift gillnets, set gillnets, and, in small numbers, beach seines. The regional salmon fisheries commence in early May and continue well into September each year. The ex-vessel value of salmon landed in Cook Inlet has been declining with a high of $35.2 million in 1997 to a low of $8.8 million in 2001 (MMS 2003).

The groundfish fishery is the largest commercial fishery in Alaska by volume and value. The lower Cook Inlet longline fishery primarily harvests sablefish (black cod), Pacific cod, and halibut. Groundfish landings and ex-vessel earnings in the Cook Inlet area for sablefish, rockfish, lingcod, Pacific cod, Pollock, and others species have varied substantially over time. Halibut is the major commercial groundfish fishery in the Cook Inlet area with landings (Homer, Kenai, Ninilchik, Seldovia, and Seward) totaling 15,346,912 pounds in 2000 and 19,787,911 pounds in 2001. Due to low stock abundance, the 2002 Cook Inlet fishery for pollock is closed, except for bycatch. Also, for this reason, the sablefish, rockfish, and lingcod fisheries of the Cook Inlet area are subject to short seasons, emergency orders, gear restrictions, trip limits, restricted fishing locations, parallel or directed fishery restrictions, or several of the above. The 2002 Cook Inlet fishery for Pacific cod is bycatch only for longline gear, but is open to pot and jig gear (with some conditions) (MMS 2003).

7.2 Recreational Fishery

Recreational (sport) fisheries of Cook Inlet were described in the *Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 Final Environmental Impact Statement* (MMS 2003), which includes the area covered under the proposed NPDES general permit. Relevant information from this EIS is provided below (MMS 2003).

The marine sport fisheries of Cook Inlet are the focus of a large and growing recreation-based economic sector. Sport fishing provides monetary benefits to tourism-related businesses. Sport fishing in Cook Inlet is primarily for Pacific halibut. The marine salmon fishery (i.e., chinook and coho) is both a substitute and complement for the halibut sport fishery. The number of vessels licensed for sport or sport/commercial fishing off Alaska has increased steadily from 500 in 1984 to more than 1,500 in 1996. The person-days fishing on charters in lower and central Cook Inlet during 1997 totaled approximately 79,000; on private or bare-boat charters, 91,000; and shore-based, 28,000—with the total of all modes being 198,000. Sport fishers include local fishers from the Kenai Peninsula, other Alaskans (from outside the Kenai Peninsula), and nonresidents of Alaska.. The average daily expenditures for lower and central Cook Inlet sport-fishing trips in 1997 and 1998 ranged from $32 for a local resident fishing from shore to $294 for a nonresident of Alaska on a charter. The total expenditures by all sport fishers fishing in lower and central Cook Inlet directly attributable to a saltwater halibut and salmon fishing trip in 1997 was $34 million (MMS 2003).

The sport-fishing charters and shore-based fishing include: Anchor River, Whiskey Gulch, Deep Creek, and Ninilchik River; other Cook Inlet and Gulf Coast areas west of Gore Point; other Cook Inlet areas north of the Ninilchik River; Barren Islands, Seldovia; Homer Spit; and various points along the shoreline (derived from Herrmann, et al. 2001; Lee et al. 1999). The saltwater sport fishery in Cook Inlet, fresh water sport fishery on the Kenai Peninsula, and clamming on the shores of Cook Inlet are an important part of the overall economy (MMS 2003).

7.3 SUBSISTENCE HARVESTS

The Alaska National Interest Land Conservation Act defines subsistence as customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter or sharing for personal or family consumption; and for customary trade (16 USC Section 3113). Subsistence hunting, fishing, and trapping occur year-round throughout the entire Cook Inlet region. Subsistence foods include salmon, other fish, big game, small game and furbearers, marine mammals, birds and eggs, marine invertebrates, and plants and berries. The harvest and use of these foods represent activities with significant social and cultural meaning as well as economic importance, especially within Alaskan Native communities. Subsistence activities are given the highest cultural values by local Cook Inlet Dena'ina, Kenaitze, Alutiiq, and Koniag Native harvesters and provide a sense of identity in addition to being an important economic pursuit (MMS 2003).

Community subsistence-harvest patterns were described in the *Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 Final Environmental Impact Statement* (MMS 2003), which includes the area covered under the proposed NPDES general permit. Information from this EIS is provided in the subsections below (MMS 2003).

7.3.1 Upper Cook Inlet

Tyonek, on the west side of Cook Inlet, traditionally a subsistence harvest area that extends from the Susitna River south to Tuxedni Bay; subsistence harvests concentrate in areas west and south of Tyonek (MMS 2003). Moose and salmon are the most important subsistence resources, although important components of the harvest include nonsalmon fish such as smelt, waterfowl, clams, and a traditionally important beluga whale hunt (ADNR 1999).

The subsistence harvest of salmon is provided through a set gillnet fishery. Because of their early arrival and large size, chinook (king) salmon are an important part of the subsistence harvest. Coho salmon are harvested for subsistence and commercial sale; sockeye, pink, and chum salmon harvests are important primarily for commercial sale. Salmon makes the largest contribution, by weight, to mean household harvest. Chinook salmon are cut into steaks, fillets, and strips for smoking; a variety of traditional products are made from the head, tail, fins, backbone, roe and milt sacks, heart, and stomach. The entire fish is used, and no portion is wasted (ADNR 1999). Salmon fishing begins in the spring, and coho fishing continues into September (MMS 2003).

Dolly Varden and rainbow trout are caught using rod and reel in local fresh water streams throughout the summer (MMS 2003). September begins the harvest season for moose. Moose hunting is done locally off a local network of logging roads and by boat in regional river drainages. A prime location is Trading Bay. Fishing and gathering activities are normally combined with the moose hunt. After salmon, moose make the second-highest contribution by weight to the annual household subsistence harvest. Waterfowl are hunted at the mouths of Nikolai Creek, Middle River, and McArthur

River. Harbor seals are hunted opportunistically along the shorelines of Trading and Redoubt Bays (ADNR 1999).

During the summer, villagers organize hunting trips for beluga whales, which are hunted in stream mouths (MMS 2003). Hunting takes place in upper Cook Inlet from Anchorage to the Beluga River at important locations that include the mouths of the Susitna, Theodore, and Beluga rivers. Most hunting occurs between mid-April and mid-October. In the last several years, the hunt has concentrated at the mouth of the Susitna River and toward Knik. Hunters use open-top dories and harpoons and buoys that minimize the loss of a struck whale. Weather is a major factor in hunting success, and Cook Inlet's shallow waters are notoriously dangerous. Beluga meat is eaten fresh after roasting or boiling and is also preserved by freezing. Beluga blubber is rendered into oil and refrigerated for use in cooking (Stanek 1994; ADNR 1999).

Federal marine mammal regulations have allowed Alaska Natives to continue this hunt although the harvest has been reduced to a single annual strike due to the crash of the Cook Inlet beluga population in 1998 and their now-official status as a depleted species (MMS 2003). A second annual strike has been allocated to the Alaska Native Marine Mammal Hunters' Committee for Anchorage-area subsistence hunters who are not Tyonek residents (O'Harra 2002; NMFS 2002b).

The gathering of wild celery, wild rhubarb, rosehips, and other plants occurs during the summer (MMS 2003). High- and low-bush cranberries, salmonberries, blueberries, and crowberries are harvested in the fall. Winter is a time of relatively low activity in the annual cycle of subsistence life for west Cook Inlet residents. Hunting for ptarmigan, spruce grouse, and hare continues throughout the winter, and a few Tyonek residents trap furbearers from mid-November until the end of winter (ADNR 1999).

7.3.2 Central Kenai Peninsula

The Kenaitze, a group of Dena'ina Athabascans, have made use of Cook Inlet natural resources for generations (MMS 2003). The Kenaitze have dried and smoked fish and picked berries over the years without any direct relationship to size of personal income. A Kenaitze Tribal Fishery was first allowed by the State of Alaska, Dept. of Fish and Game in 1989. Fishing dates vary from year to year, and in 1995, fishing was conducted from May 1 to October 15. Fishing occurs primarily in coastal marine waters south of the mouth of the Kenai River and occasionally immediately upstream of the Warren Ames Bridge in Kenai. The tribal office reported the 1997 harvest at 142 chinook; 2,410 sockeye; 5 pink; and 191 coho salmon (ADNR 1999).

Residents of Ninilchik and members of the Kenaitze Tribe subsist on fish resources—primarily salmon—that occur on the east side of Cook Inlet. Major resources harvested are salmon, halibut, and butter and razor clams. Established in 1993, the Ninilchik Traditional Council Fishery allows for a local subsistence salmon harvest. Fishing time varies, but it is normally held from May 8 to September 30 (MMS 2003). The harvest totals for the 1997 season were 302 chinook, 241 sockeye, 99 coho, and 55 pink salmon (most recent harvest data). Ninilchik residents harvest moose in the fall after the fishing season is over (ADNR 1999).

7.3.3 Lower Kenai Peninsula

Residents of Seldovia, Port Graham, and Nanwalek are the primary subsistence harvesters of the lower Kenai Peninsula, and, since the *Exxon Valdez* oil spill fouled local traditional clamming areas, residents of Nanwalek and Port Graham have used the area around Ninilchik for the harvest of razor clams (MMS 2003). Subsistence harvest of fish, wildlife, and vegetation also occurs at the head and along the southern shore of Kachemak Bay. Area residents harvest seals, sea lions, and sea otters around Yukon Island and Tutka Bay. Primary waterfowl harvest areas are in the vicinity of Seldovia, Tutka, and China. Poot bays and McKeon and Fox River flats. Seabirds and their eggs also are harvested. Along local shorelines, moose, black bear, and mountain goats are hunted. Port Graham and Nanwalek residents harvest salmon in Nanwalek and Koyuktolik ("Dogfish") bays. Seldovians gather berries in larger quantities than any of the other Kenai Peninsula subsistence communities (ADNR 1999).

Residents of Nanwalek and Port Graham prefer such resources as clams, moose, bear, and especially salmon. These resources provide large quantities of food during a short period of the year and also are preserved for use throughout the remainder of the year. A combination of commercial, subsistence, and rod-and-reel fisheries provide salmon for domestic use. Residents of Nanwalek and Port Graham participate in permitted general subsistence and personal use fisheries that have existed in upper Cook Inlet since 1991. These fisheries also are open to non-Natives. Dipnet fisheries take place on the Kenai and Kasilof rivers and on Fish Creek. A set gillnet fishery takes place on the Kasilof River from June 21 until closed by emergency order or when approximately 5,000–10,000 sockeye salmon have been taken. In addition, a general Kachemak Bay subsistence and personal-use salmon fishery has taken place since before statehood. This fishery uses Fox River drainage salmon runs returning and hatchery stocks returning to the fishing lagoon on Homer Spit and to Fox Creek. In 1993, 326 permits were issued and 1,990 coho, 463 pink, 44 sockeye, 18 chum, and 6 Chinook salmon were harvested (ADNR 1999) (MMS 2003).

Other resources such as trout, cod, halibut, chitons, snails, and crabs generally are used fresh in season. Harbor seals and sea lions are highly valued marine mammals; they are harvested year-round and are extensively shared within the community. A variety of plants also are harvested in Kachemak Bay. Bull kelp, rockweed, and brown seaweeds are collected from intertidal areas, and shoreline areas provide seaside plantain, rye grass, beach pea, wild parsley, and cow parsnip. Seldovia, Kasitsna, and Jakolof bays are important areas for the harvest of marine invertebrates (MMS 2003).

Often overlooked as a means of subsistence, gardening has been part of village life since Russian times (MMS 2003). Potatoes, cabbage, and turnips were brought to the Kenai Peninsula by Russian settlers who planted subsistence gardens out of the need for fresh vegetables (Fall 1981). A variety of local wild berries are picked; particularly low- and high-bush cranberries, rosehips, blueberries, moss berries, and wild raspberries. Locally harvested subsistence foods are distributed widely among community households (ADNR 1999).

7.4 Effects of Wastestream Discharges on Harvest Quantity and Quality

The routine activities associated with exploration, development, and production in the area covered by the proposed NPDES general permit are predicted to have insignificant impacts on the quantity or quality of the commercial, recreational, or subsistence harvests in Cook Inlet, on the basis of the potential effects of disturbance on subsistence resources, the mobility of harvested species, the potential effects of permitted discharges on water quality, and the rapid dilution of discharges by the strong tidal flux of Cook Inlet (MMS 2003).

8.0 Coastal Zone Management and Special Aquatic Sites

8.1 Coastal Zone Management

8.1.1 Requirements of the Coastal Zone Management Act

The Coastal Zone Management Act requires that states make consistency determinations for any federally licensed or permitted activity affecting the coastal zone of a state with an approved Coastal Zone Management Program (CZMP) (16 USC Section 1456(c)(A) Subpart D). Under the Act, applicants for federal licenses and permits must submit a certification that the proposed activity complies with the state's approved CZMP. The state then has the responsibility to either concur with or object to the consistency determination (SAIC 2001).

Consistency certifications are required to include the following information (15 CFR 930.58):

- A detailed description of the proposed activity and its associated facilities
- A brief assessment relating the probable coastal zone effects of the proposal and its associated facilities to relevant elements of the CZMP
- A brief set of findings indicating that the proposed activity, its associated facilities, and their effects are consistent with relevant provisions of the CZMP
- Any other information required by the state

8.1.2 Relevance of Requirements

Consistency determinations are required if a federally licensed or permitted activity *affects* the coastal zone. Waste stream discharges during extraction, development, and production activities in Cook Inlet will occur in state waters. Therefore, a consistency assessment is required (SAIC 2001).

8.1.3 Status of Coastal Zone Management Planning

In 1978, Alaska adopted the Standards of the Alaska Coastal Management Program (ACMP) at 6 AAC 880 and the Guidelines for District Coastal Management Programs at 6 AAC 85. The ACMP was approved by the U.S. Department of Commerce in 1979. The ACMP has evolved significantly since 1979. Each district coastal management plan, statutory or regulatory revision, or other program amendment that gains state and federal approval is incorporated into the ACMP. The most recent amendment of the ACMP dated June 2, 2005, includes 2 chapters of statutes, 3 chapters of regulations, 33 coastal district plans, and 33 areas meriting special attention and special area management plans (ADNR 2005).

As required under AS 46.40.040, Alaska has adopted regulations at 11 AAC 112 and 11 AAC 114 that provide the coastal districts with the guidance needed to develop their coastal district plans and enforceable policies. Completed District Coastal Management Plans (CMPs) must be approved by Alaska Department of Natural Resources (DNR). The approval of a district CMP is contingent upon development and compliance with the state standards and plan criteria, as generally summarized at AS 46.40.070(a). Once a District CMP has been approved by DNR, that plan becomes an integral part of the ACMP as the enforceable policies of that plan become enforceable as a matter of state law (ADNR 2005).

The proposed project falls under the provisions of the Kenai Peninsula Borough (KPB) CMP (KPB 1990). The KPB CMP includes issues, goals, objectives, and policies directly related to energy and industrial development. These policies are implemented through local review of state and federal permit applications and through borough land use planning and zoning regulations (SAIC 2001).

8.1.4 Relevant Policies

Policies of the ACMP that are potentially relevant to discharges from oil and gas exploration, development, and production facilities are set forth in the ACMP standards (6 AAC Chapter 80). Article 2 sets forth standards related to a number of uses and activities in the Alaska coastal zone. It sets forth the following policy for subsistence uses: "Districts and state agencies shall recognize and assure opportunities for subsistence usage of coastal areas and resources." This policy is designed to be fully implemented in district CMPs.

Article 3 sets forth standards for resources and habitats that are relevant to discharges from oil and gas exploration, development, and production. Of the habitat types it identifies, the following habitats could be affected by these discharges: offshore areas, estuaries, wetlands and tideflats, and exposed high energy coasts. The fundamental standard for management of these habitats is that they "must be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat that contribute to its capacity to support living resources" (6 AAC 80.130[b]).

The Kenai Peninsula Borough CMP was federally approved by the Department of Commerce in June 1990 and includes state coastal waters in Cook Inlet. The Kenai Peninsula Borough CMP incorporates the state policies and adds the following enforceable policies:

- Structures, pipelines and buoys placed in navigable waters shall be visibly marked and placed to minimize navigation hazards or obstruction (KPB CMP Enforceable Policy 2.1).
- To the extent feasible and prudent, all temporary and permanent developments, structures, and facilities in marine and estuarine waters shall be sited, constructed,

and operated in a manner that does not create a hazard or obstruction to commercial fishing operations (KPB CMP Enforceable Policy 2.3[a]).

- Within marine and estuarine waters of the coastal area, operators of activities relating to oil, gas, and mining exploration and production, shall provide timely written notification to a list of fishing organizations maintained by the Kenai Peninsula Borough to apprise commercial fishing interests of the schedule and location of development activities prior to initiation of the project. This notice shall include a schedule of activities and a map or description of any potential conflicts or physical obstructions that may impact or preclude commercial fishing opportunities or damage/contaminate fishing gear including but not limited to subsea pipelines, subsea wellhead structures, and modifications to the natural shoreline topography or sea-bottom profile (e.g., causeways, artificial islands, dredge spoil disposal sites) (KPB CMP Enforceable Policy 2.3[b]).

- To the extent feasible and prudent, offshore resource exploration and development activities shall be scheduled and/or located to avoid interference with commercial fishing and subsistence activities (KPB CMP Enforceable Policy 2.3[c]).

- Projects that require dredging or filling in streams, rivers, lakes, wetlands, or saltwater areas including tideflats, will be located, designed, constructed, and maintained in a manner so as to: (a) avoid significant impacts to important fish and wildlife habitat; (b) avoid significant interference with fish migration, spawning, and rearing as well as other important life history phases of wildlife; (c) limit areas of direct disturbance to as small an area as possible; (d) minimize the amount of waterborne sediment traveling away from the dredge or fill site; and (e) maintain circulation and drainage patterns in the area of the fill (KPB CMP Enforceable Policy 2.4).

- Dredged materials disposed onshore will be diked or similarly contained and stabilized in order to prevent erosion or leaching of harmful or toxic substances into wetlands or fishbearing waters (KPB CMP Enforceable Policy 2.5).

- All land and water use activities shall be planned and conducted to mitigate potential adverse impacts on fish and wildlife populations, habitats, and harvest activities. Mitigation shall include the following sequential steps: (a) avoid the loss of natural fish and wildlife populations, habitat, and harvest activities; (b) when the loss cannot be avoided, minimize loss by incorporating measures to reduce the amount or degree of loss; (c) when the loss cannot be avoided or minimized, restore or rehabilitate the resource that was lost or disturbed to its pre-disturbance condition, to the extent feasible and prudent; and (d) when loss or damage is substantial and irreversible and the above objectives cannot be achieved, compensation for the resource and/or harvest loss shall be considered. In the case of loss of habitat production potential, enhancement of other habitats shall be considered as an alternative means of compensation. In general, compensation with similar habitats in the same locality is preferable to compensation with other types of habitat or habitats located elsewhere. The cost of mitigation relative to the benefits to be gained will be considered in the implementation of the policy (KPB CMP Enforceable Policy 2.6).

- Development in areas with known geological hazards shall be located, designed, constructed and managed to minimize risk to human life and property damage (KPB CMP Enforceable Policy 3.1)

- Development and resource extraction activities shall be sited and conducted to minimize accelerated shoreline erosion or adverse impacts to shoreline processes. Developers shall retain existing vegetative cover in erosion-prone areas to the greatest extent feasible and prudent. In cases where development or other activities lead to removal of vegetation, erosion shall be prevented or, if it occurs, shall be remedied through revegetation or by other appropriate measures (KPB CMP Enforceable Policy 3.3).

- Public access routes to coastal waters and recreational land shall be maintained and to the extent feasible and prudent, increased when public land is leased, disposed, or subdivided (KPB CMP Enforceable Policy 4.4).

- Commercial/industrial operations shall use necessary measures to prevent drilling wastes, oil spills, and other toxic or hazardous materials from contaminating surface and ground water (KPB CMP Enforceable Policy 5.2[a]).

- Any industrial water withdrawal shall comply with the requirements of AS 46.15 and may require that aquifer testing of the production well(s) and monitoring of nearby public or private wells be conducted. Results of testing shall be submitted to the Kenai Peninsula Borough and the Alaska Department of Natural Resources. These results should demonstrate what effects the withdrawal of water necessary to serve the fully developed project will have on prior water rights holders within the area of influence (KPB CMP Enforceable Policy 5.2[b]).

- To the extent feasible and prudent, existing industrial facilities or areas and pipeline routes shall be used to meet new requirements for exploration and production support bases, transmission/shipment (including pipelines and transportation systems), and distribution of energy resources (KPB CMP Enforceable Policy 5.3).

- Projects that require dredging, clearing, or construction in productive habitats shall be designed to keep these activities to the minimum area necessary for the project (KPB CMP Enforceable Policy 5.4).

- Activities associated with oil and gas resource exploration, industrial development, or production shall minimize navigational interference and be located or timed to avoid potential damage to fishing gear. Offshore pipelines and other underwater structures will be located, designed, or protected so as to allow fishing gear to pass over without snagging or otherwise damaging the structure or gear (KPB CMP Enforceable Policy 5.5).

- Pipelines and pipeline right-of-ways shall, to the extent feasible and prudent, be sited, designed, constructed, and maintained to avoid important fishing grounds and to minimize risk to fish and wildlife habitats from a spill, pipeline break, or other construction activities. Pipeline crossings of fishbearing waters and wetlands important to waterfowl and shorebirds shall incorporate mitigative measures, to the extent feasible and prudent, to minimize the amount of oil that may enter such waters as a result of a pipeline rupture or leak (KPB CMP Enforceable Policy 5.6).

- Debris from offshore construction activities shall be removed to an approved onshore disposal site on or before completion of construction (KPB CMP Enforceable Policy 5.7).

- Oil produced in offshore areas shall be transported to shore for storage unless transport is determined to have a greater potential for adverse environmental impact than offshore storage (KPB CMP Enforceable Policy 5.8[a]).

- Oil storage facilities shall be located and bermed in accordance with Policy 13.2 in the Air, Land, and Water Quality section of these policies (KPB CMP Enforceable Policy 5.8[b]).

- Geophysical surveys will, to the extent feasible and prudent, be located, designed, and constructed in a manner so as to avoid disturbances to fish and wildlife populations, habitats, and harvests. Seasonal restrictions, restrictions on the use of explosives, or restrictions relating to the type of transportation used in such operations will be included as necessary to mitigate potential adverse impacts (KPB CMP Enforceable Policy 5.9[a]).

- Geophysical surveys in fresh and marine waters supporting fish or wildlife will require the use of energy sources such as airguns, gas exploders, or other sources that have been demonstrated to be harmless to fish and wildlife and human uses of fish and wildlife. Blasting for purposes other than geophysical surveys will be approved on a case-by-case basis after all steps have been taken to minimize impacts and when no feasible and prudent alternatives exist to meet the public need (KPB CMP Enforceable Policy 5.9[b]).

- Vessels engaged in offshore geophysical exploration will conduct their operations to avoid significant interference with commercial fishing activities (KPB CMP Enforceable Policy 5.9[c]).

- To the extent feasible and prudent, existing pipeline and utility corridors shall be used for new facilities or expansion of existing facilities, rather than developing new corridors (KPB CMP Enforceable Policy 6.4[a]).

- To the extent feasible and prudent, underwater pipelines shall be buried. If pipelines are not buried shall be designed to allow for the passage of fishing gear, or the pipeline route shall be selected to avoid important fishing areas, and anadromous fish migration and feeding areas (KPB CMP Enforceable Policy 6.4[c]).

- All uses and activities in areas traditionally used for subsistence shall accommodate the use of subsistence resources in the planning, development, and operation of these activities (KPB CMP Enforceable Policy 11.1).

- Projects in areas traditionally used for subsistence shall be located, designed, constructed, and operated to minimize adverse impacts to subsistence resources and activities (KPB CMP Enforceable Policy 11.2).

- Land and water use plans for public land and waters surrounding the communities of English Bay, Port Graham, Seldovia, and Tyonek shall avoid or minimize impacts to subsistence resources and activities (KPB CMP Enforceable Policy 11.3).

- Maintenance and enhancement of fish habitat shall be the highest priority use when reviewing proposals for activities which may adversely impact critical spawning, rearing, migration or overwintering areas for fish and shellfish (KPB CMP Enforceable Policy 12.1).

- Appropriation of surface or intergravel waters from streams shall not occur at a withdrawal rate or timing which adversely affects anadromous fish habitat, as determined by the Alaska Department of Fish and Game, unless, under the procedures outlined in AS 46.15, the Commissioner of the Department of Natural Resources makes a finding based on public review that the competing use of water is the best public interest and no feasible and prudent alternative exists (KPB CMP Enforceable Policy 12.2).

- Development activities, facilities and structures shall be designed, sited, constructed and operated in a manner which does not impede or interfere with timely access and movement of fish. Causeways, gravel berms, culverts, and other obstructions or constrictions to fish movement are of particular concern. Existing fish passage problems, including perched culverts, man-made stream obstructions, and velocity barriers shall be corrected by the entity responsible for the problem (KPB CMP Enforceable Policy 12.3).

- Water intake pipes used to remove water from fishbearing waters shall be surrounded by a screened enclosure and velocity shall be limited so as to prevent fish entrainment and impingement (KPB CMP Enforceable Policy 12.5).

- To protect fish, sensitive marine mammals, and other aquatic fauna, explosives shall not be detonated within, beneath, or adjacent to marine, estuarine, or fresh waters that support fish and wildlife during periods when fish or marine mammals are present unless the detonation of the explosives produces an instantaneous pressure rise in the water body of no more than 2.5 pounds per square inch (psi) or unless the water body, including its substrate, is frozen (KPB CMP Enforceable Policy 12.6).

- Seabird colony sites and haulouts and rookeries used by sea lions and harbor seals (as identified in ADFG Regional Guides or with the best available information at the time of project review) shall not be physically altered or disturbed by structures or activities in a manner that would preclude or interfere with continued use of these sites. To the extent feasible and prudent, development structures and facilities with a high level of noise, acoustical or visual disturbance shall maintain a one-half mile buffer from identified use areas for sea lions, harbor seals, and marine birds during periods when these species are present (KPB CMP Enforceable Policy 12.7).

- Uses and activities within or adjacent to coastal waters shall not interfere with migration or feeding of whales. Interference refers to conduct or activities that disrupt an animal's normal behavior or cause a significant change in the activity of the affected animal (KPB CMP Enforceable Policy 12.8).

- Activities shall avoid harming or disturbing bald eagles or their nest sites in accordance with the Bald Eagle Protection Act (16 USC 668) by timing operations when eagles are not breeding or nesting (generally September 1 to March 1), retaining a buffer of undisturbed natural vegetation around occupied and unoccupied nest trees, or both. The use and size of buffers shall be determined on a case-by-case basis by the U.S. Fish and Wildlife Service and Alaska Department of Fish and Game and may vary with topography, timber type, wind firmness, type of activity, or other factors, but will generally be about 330 feet wide (KPB CMP Enforceable Policy 12.9).

- Hazardous materials, petroleum, or petroleum products as defined in State and federal regulations, shall not be disposed of in the Borough unless done so at a facility designed and approved for this purpose (KPB CMP Enforceable Policy 13.1).

- If previously undiscovered artifacts or areas of historic, prehistoric, or archaeological importance are encountered during development activities, the site shall be protected from further disturbance, and the State Historic Preservation

Office shall immediately be notified to evaluate the site or artifacts (KPB CMP Enforceable Policy 14.2).

- The Borough shall pursue the development and adoption of policies and plans relating to the prevention and cleanup of oil spills (KPB CMP Enforceable Policy A6).

8.1.5 Consistency of Waste Discharges with Relevant Coastal Management Programs and Policies

On the basis of the analysis presented in this ODCE, discharges associated with oil and gas exploration, development, and production facilities in the area covered under the proposed NPDES general permit appear to comply with relevant ACMP policies. This assessment is based on the following findings:

- From the analysis in Section 7 of this ODCE, opportunities for subsistence use of coastal resources are unlikely to be threatened by discharges from the facilities covered under the proposed NPDES general permit.

- Coastal habitats will be managed to maintain the biological, physical, and chemical characteristics of the habitats that contribute to their capacity to support living resources. This finding is based on analyses in Sections 5 and 6 of this ODCE indicating that coastal habitats are unlikely to experience significant adverse impacts from discharges of drilling fluid and cuttings.

- Offshore areas will be managed to maintain sport, commercial, and subsistence fisheries. This finding is based on analyses in Section 7 indicating that recreational, commercial, and subsistence harvests are unlikely to experience degradation from waste discharges.

- Estuaries, wetlands, and tideflats will not be adversely affected by toxic waste discharges. This finding is based on analyses in Section 3 indicating that any toxic substances in the discharges will be rapidly diluted and are not likely to be detectable in the vicinity of coastal habitats.

- Mixing and transport processes of high energy coasts will not be affected by discharges of drilling fluid and cuttings regulated under the proposed NPDES general permit.

8.2 SPECIAL AQUATIC SITES

Effects of discharges from the Osprey Platform on biologically important communities are evaluated in Sections 5 and 6.

The following Areas Meriting Special Attention (AMSAs), State Game Refuges (SGRs), State Game Sanctuaries (SGSs), Critical Habitat Areas (CHAs), and National Park are in the area covered by the proposed NPDES general permit:

Palmer Hay Flats SGR	Kachemak Bay CHA
Kalgin Island CHA	Lake Clark National Park
Susitna Flats SGR	Goose Bay SGR
Anchorage Coastal Wildlife Refuge	Clam Gulch CHA
Port Graham/Nanwalek AMSA	McNeil River SGS
Trading Bay SGR	Redoubt Bay CHA
Potter Point SGR	

All facilities covered under the proposed NPDES general permit are prohibited from discharging within the boundaries or within 4,000 meters of a coastal marsh, river mouth, designated AMSA, SGR, SGS, CHA, or National Park. The legal descriptions of these state special areas can be found in Alaska Statute section 16.20. The present boundaries of these state special areas are described in *State of Alaska Game Refuges, Critical Habitat Areas, and Game Sanctuaries,* Alaska Department of Fish and Game, Habitat Division, March 1991.

8.3 SUMMARY

Waste discharges associated with oil and gas exploration, development, and production facilities in the area covered under the proposed NPDES general permit for Cook Inlet are expected to be consistent with relevant ACMP policies. Discharges will be consistent with the objectives of subsistence uses of the coastal zone, management of coastal habitats, and management of specific habitat types (e.g., offshore areas).

9.0 MARINE WATER QUALITY

This section addresses compliance of Cook Inlet oil and gas exploration, development, and production facility discharges with federal technology-based limits, State of Alaska Water Quality Standards (18 AAC 70), and federal Ocean Discharge Criteria.

9.1 TECHNOLOGY-BASED LIMITS

Technology-based limits required under the Effluent Limit Guidelines (ELGs) are contained in the proposed NPDES general permit. The ELGs established BCT, BAT, BPT, and NSPS for the Offshore and Coastal Subcategories of the Oil and Gas Extraction Point Source Category (40 CFR Part 435, Subparts A and D). This section describes the associated limitations and monitoring requirements for the individual wastestreams authorized by the proposed NPDES general permit.

9.1.1 Drilling Fluids

The following limits and prohibitions are based on the ELGs: (1) no discharge of free oil; (2) no discharge of diesel oil; (3) a toxicity limit of 3 percent by volume. The proposed NPDES general permit limits the discharge of organic contaminants through these free oil and diesel oil prohibitions, and by restricting the use of mineral oil in drilling fluids. Permittees must measure free oil in drilling fluid discharges using the static sheen test method. Permittees must measure toxicity using a 96-hour LC_{50} on the suspended particulate phase using the *Mysidopsis bahia* species.

Stock barite, which is added to drilling fluids, contains cadmium and mercury and is the main source of heavy metals in drilling fluid discharges. Pursuant to the ELGs, the proposed NPDES general permit establishes effluent limitations for cadmium and mercury of 3 mg/kg and 1 mg/kg, respectively. The proposed NPDES general permit will require permittees to report cadmium and mercury concentrations measured in the stock barite before it is added to the drilling fluids using USEPA Test Methods 245.5 or 7471. The technology-based limits for cadmium and mercury are surrogate parameters for other metals contained in the barite.

The proposed NPDES general permit prohibits discharges of oil-based drilling fluids, inverse emulsion drilling fluids, oil-contaminated drilling fluids, and drilling fluids to which mineral oil has been added. The purpose of these prohibitions is to ensure compliance with the toxicity limit and the prohibition against the discharge of free oil. The proposed NPDES general permit allows an exception to those prohibitions for drilling fluids to which mineral oil or nonaqueous-based fluids have been added as a carrier agent, lubricity additive, or pill.

The proposed NPDES general permit prohibits discharges of nonaqueous based drilling fluids. In territorial seas and federal waters, however, permittees are authorized to discharge nonaqueous-based drilling fluids that adhere to drill cuttings, pursuant to the

Offshore Category ELGs, as amended in 2001. The limitations that apply to these proposed new drill cuttings discharges are described in Section 9.2.

9.1.2 Drill Cuttings

The main source of pollutants in drill cutting discharges come from drilling fluids that are used in drilling a well that then adhere to the drill cuttings. Therefore, on the basis of the ELGs for BAT, BCT, BPT, and NSPS, drill cuttings discharges are subject to the same limits that apply to drilling fluid discharges as described in the proposed NPDES general permit fact sheet.

As noted above, in territorial seas and federal waters, the proposed NPDES general permit would authorize the discharge of drill cuttings generated using synthetic-based drilling fluids. The use of synthetic-based fluids is a type of pollution prevention technology because the drilling fluids are not disposed of through bulk discharge at the end of drilling. Instead, the drilling fluids are brought back to shore and refurbished so they can be reused. In addition, drilling with synthetic-based fluids allows operators to drill a slimmer well and causes less erosion of the well during drilling than when water-based fluids are used, reducing the volume of drill cuttings that are discharged. The proposed NPDES general permit requires permittees to remove synthetic-based drilling fluids from the drill cuttings prior to discharge, which is not required when water-based fluids are used.

The ELGs also include limits for sediment toxicity and biodegradation. Although the ELGs do not address specific types of synthetic-based fluids, the ELGs contain toxicity and biodegradation limits that require operators to use less toxic fluids that biodegrade quickly.

The proposed NPDES general permit contains limits for synthetic-based fluids at three points. First, for stock synthetic fluids prior to combination with other components of the drilling fluids system, the proposed NPDES general permit imposes limits on polynuclear aromatic hydrocarbons (PAHs), sediment toxicity (10-day), and biodegradation rate. Second, combined fluid components are limited for formation oil contamination, measured using gas chromatography/mass spectrometry (GC/MS). Third, drilling fluids that adhere to drill cuttings are limited for sediment toxicity (4-day), and formation oil contamination as measured by either a reverse phase extraction test or GC/MS.

9.1.3 Produced Water

Operations in waters subject to this analysis would be prohibited from the discharge of produced water.

9.1.4 Produced Sand

The proposed NPDES general permit retains the existing NPDES general permit's prohibition of the discharge of produced sand accord to the ELGs.

9.1.5 Well Treatment, Completion, and Workover Fluids

For well treatment, completion, and workover fluid discharges, the ELGs for NSPS and BAT require oil and grease limits of 29 mg/L, monthly average, and 42 mg/L, daily maximum. In addition, the BCT ELGs require a limit of no free oil. These limits were contained in the existing NPDES general permit and are retained in the proposed NPDES general permit.

9.1.6 Deck Drainage

For deck drainage discharges, the Offshore and Coastal Subcategory ELGs for NSPS, BAT, and BCT require a limitation of no discharge of free oil as determined by the presence of film, sheen, or a discoloration of the surface of the receiving water. This limit was contained in the existing NPDES general permit and has been retained in the proposed NPDES general permit.

9.1.7 Sanitary Wastewater

For sanitary waste discharges, the Offshore and Coastal Subcategory ELGs for NSPS and BCT require total residual chlorine to be maintained as close to 1 mg/L as possible for facilities that are continuously manned by 10 or more persons. The ELGs also require no discharge of floating solids for offshore facilities that are continuously manned by nine or fewer persons or intermittently manned by any number of persons. These limits were contained in the existing NPDES general permit and are retained in the proposed NPDES general permit.

9.1.8 Domestic Wastewater

For domestic waste discharges, the ELGs prohibit the discharge of floating solids, garbage, or foam and require compliance with 33 CFR Part 151. This limit was contained in the existing NPDES general permit and has been retained in the proposed NPDES general permit.

9.1.9 Miscellaneous Discharges

The existing NPDES general permit authorized miscellaneous discharges from desalination wastewater (005); blowout preventer fluid (006); boiler blowdown (007); fire control system test water (008); noncontact cooling water (009); uncontaminated ballast water (010); bilge water (011); excess cement slurry (012); muds, cuttings, and cement at the sea floor (013); and waterflood wastewater (014). The existing NPDES general permit limited those discharges to no free oil as monitored by the visual sheen test method. The existing NPDES general permit required discharges of uncontaminated ballast water and bilge water to be treated in an oil-water separator. The existing NPDES general permit also required operators to sample bilge water discharges for free oil using the static sheen test method when discharges occurred during broken, unstable, or stable ice conditions. In addition, the existing NPDES general permit required operators to maintain a precise inventory of the type and quantity of chemicals added to waterflooding, noncontact cooling water, and desalinization wastewater discharges. The ELGs do not address these miscellaneous discharges. To satisfy antibacksliding requirements, the proposed NPDES general permit retains these limitations and monitoring requirements, except, as described in Section 9.2, when treatment chemicals such as corrosion inhibitors or biocides are added.

9.1.10 Chemically-Treated Sea Water and Fresh Water Discharges

The proposed NPDES general permit uses generic BPJ-based limits, on the basis of available technology, to regulate chemically treated sea water and fresh water discharges, rather than attempting to limit the discharge of specific biocides, scale inhibitors, and corrosion inhibitors. Due to the large number of chemical additives used, it would be very difficult to develop technology-based limits for each individual additive. In addition, if the proposed NPDES general permit were to limit specific chemicals, it could potentially halt the development and use of new and potentially more beneficial treatment chemicals.

Many of the chemicals normally added to sea water or fresh water, especially biocides, have manufacturer's recommended maximum concentrations or EPA product registration labeling. In addition, information obtained from offshore operators demonstrates that it is unnecessary to use any of the chemical additives or biocides in concentrations greater than 500 mg/L as described in the proposed NPDES general permit fact sheet. Therefore, the proposed NPDES general permit limits discharges of sea water or fresh water to the most stringent of the following:

- The maximum concentrations and any other conditions specified in the EPA product registration labeling if the chemical additive is an EPA-registered product.
- The maximum manufacturer's recommended concentration
- 500 mg/L

Compliance with this limit is calculated on the basis of the amount of treatment chemicals added to the volume of water discharged.

As with other miscellaneous discharges described above, the proposed NPDES general permit contains BCT limits prohibiting the discharge of free oil for chemically treated sea water and fresh water discharges. Free oil is a direct measurement of oil contamination and, on the basis of BPJ, the proposed NPDES general permit uses it as a surrogate parameter for conventional pollutants in these discharges.

9.1.11 Stormwater Runoff from Onshore Facilities

In an effort to regulate discharges from onshore production facilities similar to the manner in which such discharges are regulated for shore-based industrial facilities, EPA proposes to include new requirements in the proposed NPDES general permit. These requirements have been imposed pursuant to CWA section 402(1)(2) and 40 CFR section 122.26(c). Specifically, operators of onshore facilities are required to develop and implement stormwater pollution prevention plans (SWPPPs). The SWPPPs must include best management practices (BMPs) to monitor and maintain operations to prevent contamination of stormwater. If facilities are covered under a separate NPDES permit and have completed these requirements in compliance with that permit, these requirements would not apply.

9.1.12 All Discharges

The proposed NPDES general permit prohibits the discharge of rubbish, trash, and other refuse on the basis of the International Convention for the Prevention of Pollution from Ships (MARPOL). The proposed NPDES general permit also prohibits the discharge of sandblasting waste pursuant to 33 CFR Part 151. Operators typically use management practices such as enclosing areas being sandblasted in tarps to capture as much of the waste as practicable. The proposed NPDES general permit clarifies that the use of reasonable measures such as enclosing the area in tarps would meet the intent of the discharge prohibition.

On the basis of CWA Section 403(c), 33 USC section 1343(c), the proposed NPDES general permit also requires minimization of the discharge of surfactants, dispersants, and detergents.

9.2 WATER QUALITY-BASED PERMIT CONDITIONS

The proposed NPDES general permit establishes water quality-based limitations and monitoring requirements necessary to ensure that the authorized discharges comply with the CWA's Ocean Discharge Criteria and State Water Quality Standards, for those waters in which they apply (see Section 1.2.3 of this ODCE).

9.2.1 Ocean Discharge Criteria

Section 403 of the Act, 33 USC section 1343, requires NPDES permits for discharges into offshore waters, including territorial seas and federal waters (lower Cook Inlet in the case of the proposed NPDES general permit), to comply with the Ocean Discharge Criteria for determining the potential degradation of the marine environment. See 40 CFR Part 125, Subpart M. The Ocean Discharge Criteria are intended to "prevent unreasonable degradation of the marine environment and to authorize imposition of effluent limitations, including a prohibition of discharge, if necessary, to ensure this goal." (49 FR 65942, October 3, 1980, as cited in the proposed NPDES general permit fact sheet).

Under the Ocean Discharge Criteria, EPA may issue an NPDES permit if it determines that a discharge will not cause unreasonable degradation to the marine environment. If insufficient information exists to make such a determination prior to permit issuance, EPA may only issue the permit if the discharge will not cause irreparable harm to the marine environment while additional monitoring is undertaken, and if there are no reasonable alternatives to onsite disposal.

The MMS completed a Preliminary ODCE for Lease Sale No. 60 and a revised Preliminary ODCE for Lease Sale No. 88 and state lease sales in Cook Inlet for discharges from facilities in those lease sale areas. For the existing NPDES general permit, EPA updated the existing ODCE information in the ODCE for *Cook Inlet (Oil & Gas Lease Sale 149) and Shelikof Strait* (Tetra Tech 1994). EPA has further updated that evaluation for the proposed NPDES general permit and expanded its scope to include the areas covered under MMS Lease Sale Nos. 191 and 199 as well as adjoining territorial seas as described in the proposed NPDES general permit fact sheet.

On the basis of the Ocean Discharge Criteria, the existing NPDES general permit established discharge rate and depth limits for drilling fluids discharges as well as discharge prohibitions in several environmentally sensitive areas of Cook Inlet. The proposed NPDES general permit retains these requirements and includes new requirements based on Ocean Discharge Criteria, including toxicity limits for produced water and toxicity limits for sea water and fresh water discharges to which treatment chemicals have been added. EPA has determined that discharges authorized from the proposed NPDES general permit will not cause unreasonable degradation as long as the proposed NPDES general permit's limitations, depth-related conditions, and environmental monitoring requirements are met.

9.2.2 State Water Quality Standards

Section 301(b)(1)(C) of the Act, 33 USC section 1311(b)(1)(C), and 40 CFR section 122.44(d)(1) require NDPES permits to contain the limitations and conditions that are necessary to attain State Water Quality Standards. The existing NPDES general permit contained limits based on state water quality standards for metals, hydrocarbons, and toxicity in produced water discharges. The proposed NPDES general permit contains revised water quality-based effluent limits based on updated mixing zone computations. Proposed mixing zones are provided in Table 3 of the proposed NPDES general permit fact sheet.

In addition, treatment chemicals such as biocides, corrosion inhibitors, and oxygen scavengers are used in a number of discharges such as cooling water and waterflood wastewater. Many of those chemical additives are highly toxic, which was an issue raised by tribal members during the Traditional Ecological Knowledge interview process described the proposed NPDES general permit fact sheet. To ensure that these discharges comply with both State Water Quality Standards and Ocean Discharge Criteria, the proposed NPDES general permit includes whole effluent toxicity limitations.

Alaska marine water quality standards for the protection of aquatic life (18 AAC 70) (ADEC 2003) include the following:

> Temperature: Discharges may not cause the weekly average temperature to increase more than 1°C. The maximum rate of change may not exceed 0.5°C per hour. Normal daily temperature cycles may not be altered in amplitude or frequency.

Dissolved Inorganic Substances: Discharges may not increase the natural salinity by more than 4 parts per thousand (ppt) for waters with natural salinity between 13.5 and 35.0 ppt (as in the Forelands area of Cook Inlet).

Sediment: Discharges may not cause a measureable increase in concentration of settleable solids above natural conditions, as measured by the volumetric Imhoff cone method.

Toxics and Other Deleterious Organic and Inorganic Substances: Individual substances in the discharges may not exceed the criteria in Table IV and Table V, column B in the *Alaska Water Quality Criteria for Toxic and Other Deleterious Organic and Inorganic Substances*, May 2003, or any chronic or acute criteria established in 18 AAC 70, for a toxic pollutant of concern, to protect sensitive and biologically important life stages of resident species of Alaska. There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, toxic effects on aquatic life or produce undesirable or nuisance aquatic life, except as authorized in 18 AAC 70. Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests.

Color: Color or apparent color may not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life. For all waters without a seasonally established nor for aquatic life, color or apparent color may not exceed 50 color units or the natural condition, whichever is greater.

Petroleum Hydrocarbons, Oil and Grease: Total aqueous hydrocarbons in the water column may not exceed 15 µg/L. Total aromatic hydrocarbons in the water column may not exceed 10 µg /L. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.

Radioactivity: The discharges may not exceed the concentration specified in the Alaska Drinking Water Standards (18 AAC 80).

Residues: The discharges may not, alone, or in combination with other substances or wastes, make the water unfit or unsafe for use, or cause acute or chronic problem levels as determined by bioassay or other appropriate methods. The discharges may not, alone or in combination with other substances, cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.

9.3 MIXING ZONES

Mixing zones are established by states and EPA to specify a limited portion of a waterbody in which otherwise applicable water quality criteria may be exceeded. In the coastal waters and territorial seas, states have the authority to define mixing zones and determine their sizes. In territorial seas, the Ocean Discharge Criteria concurrently apply and can restrict mixing zone sizes. In federal waters, state standards do not apply; thus, mixing zones are governed solely by the Ocean Discharge Criteria as described in the proposed NPDES general permit fact sheet.

9.3.1 Mixing Zones and State Water Quality Standards

When authorized by ADEC, the State Water Quality Standards require mixing zones to be as small as practicable (18 Alaska Administrative Code 70.240). In determining whether to use a mixing zone, 18 AAC 70.245 requires full protection of the existing uses of the waterbody. Within a mixing zone, State Water Quality Standards allow water quality criteria for chronic aquatic life and human health protection to be exceeded as long as water quality criteria are met outside the mixing zone. Some water quality standards, however, require that acute aquatic life criteria are met at a boundary of a smaller zone of initial dilution established within the mixing zone (18 AAC 70.255). ADEC has determined that the discharges authorized by the existing NPDES general permit are not likely to persist in the environment and, therefore, has authorized mixing zones as described in the proposed NPDES general permit fact sheet.

9.3.2 Mixing Zones and Ocean Discharge Criteria

The Ocean Discharge Criteria define mixing zones to be that portion of the waterbody that extends laterally a distance of 100 meters from the discharge point (40 CFR section 125.121(c). Ocean Discharge Criteria provide EPA with the option of establishing smaller mixing zones that are based on a zone of initial dilution calculated using a plume model. The proposed NPDES general permit implements generic 100 meter mixing zones throughout the Cook Inlet for chemically treated sea water discharges in accordance with the Ocean Discharge Criteria.

9.4 CHEMICALLY TREATED SEA WATER DISCHARGES

The proposed NPDES general permit includes new water quality-based limits for miscellaneous discharges to which treatment chemicals, such as biocides, are added. Whole effluent toxicity limits in the proposed NPDES general permit are based on the effluent concentration at the edge of the mixing zone. The proposed NPDES general permit contains whole effluent toxicity and free oil limits because they are necessary to meet state water quality standards and Ocean Discharge Criteria.

Operators will be able to use treatment chemicals that are most efficient for their operations as long as they enable the facility to consistently meet effluent limits. While this approach will ensure the protection for water quality, it will also provide maximum flexibility for operators to switch to newer products that may become available.

Therefore, to ensure flexibility, the proposed NPDES general permit does not prescribe specific chemical additives that may be used.

9.4.1 Toxicity Limitations

As calculated, the toxicity limits will prevent the discharge of pollutants in concentrations that will result in chronic toxicity at the edge of a 100-meter mixing zone. Toxicity limits will ensure compliance with State Water Quality Standards (18 AAC 70.030), which states that "[a]n effluent discharges to a water may not impart chronic toxicity to aquatic organisms."

EPA calculated critical dilutions at which the toxicity limits must be met using CORMIX. Because discharges less than 10,000 gallons per day will be very dilute and are not likely to exhibit toxic effects at the edge of the mixing zone, toxicity limits are not proposed for these discharges. The proposed NPDES general permit includes a table so that operators can obtain their toxicity effluent limits according to their discharge rate.

9.4.2 Free Oil Limitations

The proposed NPDES general permit limits the discharge of free oil to help prevent the discharge of toxic pollutants contained in oil. The Ocean Discharge Criteria include 10 factors that must be considered in determining whether a discharge will cause unreasonable degradation of the marine environment (40 CFR section 125.122). One of the 10 factors is the potential impact on human health through direct and indirect pathways. 40 CFR section 110.3 defines quantities of oil that may be harmful to public health or welfare as a discharge that causes a sheen or discoloration on the receiving water. Therefore, the proposed NPDES general permit limits chemically treated sea water discharges to no free oil as measured using the visual sheen test method.

9.4.3 Sanitary Waste Discharges

The proposed NPDES general permit includes the same water-quality based limitations for BOD and TSS as the existing NPDES general permit for facilities in coastal waters and the territorial seas.

As required by CWA Section 312, 33 USC section 1322, the existing NPDES general permit limits the total residual chlorine concentration to a minimum of 1 mg/L throughout the area of coverage. The existing NPDES general permit also has a daily maximum limitation for total residual chlorine of 19 mg/L, which applies to facilities in coastal waters and the territorial seas. The proposed NPDES general permit requires effluent concentrations at the edge of the mixing zone to meet a more stringent limit 7 mg/L to meet the State Water Quality Standard of 7 μg/L with an effluent dilution of 0.1 percent. EPA expects that most permittees will install dechlorination equipment to meet this new effluent limit as described in the proposed NPDES general permit fact sheet.

9.5 SUMMARY

Discharges to state waters from exploration, development, and production facilities will include drilling fluids and drill cuttings; deck drainage; sanitary wastes; domestic wastes; desalination unit wastes; blowout preventer fluid; boiler blowdown; fire control system test water; noncontact cooling water; uncontaminated ballast water; bilge water; excess cement slurry; mud, cuttings, cement at seafloor; waterflooding discharges; produced water and produced sand; completion fluids; workover fluids; well treatment fluids; test fluids; and stormwater runoff from onshore facilities.

The volume and concentrations of pollutants in the discharges from oil and gas facilities in Cook Inlet covered under the proposed NPDES general permit are expected to meet human health water quality criteria at the end-of-pipe, as well as water quality criteria for the protection of aquatic life. Therefore, there is little potential for discharges to exceed marine water quality criteria.

10.0 DETERMINATION OF UNREASONABLE DEGRADATION

Chapter 1.0 of this ODCE provides the regulatory definition of unreasonable degradation of the marine environment (40 CFR 125.121[e]) and indicates the 10 criteria that are to be considered when making this determination (40 CFR 125.122). The actual determination of whether the discharge will cause unreasonable degradation is made by EPA Region 10's Administrator. The intent of this chapter is to briefly summarize information pertinent to the determination of unreasonable degradation.

10.1 CRITERION 1

The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged:

- Approximately 3,690 tons of drilling fluids, 5,590 tons of drill cuttings, and 7.36 million cubic meters of produced waters would be produced from oil and gas exploration, development, and production activities in Cook Inlet each year; however, discharge of drilling fluids and drill cuttings is authorized only at existing facilities (outside the application of this ODCE) and exploratory facilities; the discharge of produced water is not authorized from new sources and new exploratory facilities.

- Due to the minimal pollutant concentrations and/or low volume of the remaining discharges, the potential for bioaccumulation or persistence of contaminants is low.

- Discharges from exploration, development, and production activities are expected to meet the appropriate effluent limitation requirements listed in the proposed NPDES general permit as well as the appropriate Alaska Water Quality Standards in 18 AAC 70.

- Operators of onshore facilities are required to develop and implement stormwater pollution prevention plans (SWPPPs), which must include best management practices (BMPs) to monitor and maintain operations to prevent contamination of stormwater.

10.2 CRITERION 2

The potential transport of such pollutants by biological, physical, or chemical processes:

- Cook Inlet is a high-energy environment. Fast tidal currents and tremendous mixing produce rapid dispersion of soluble and particulate pollutants.

- Within a distance of between 100 and 200 meters from the discharge point, the turbidity caused by suspended particulate matter in discharged fluids and cuttings is expected to be diluted to levels that are within the range associated with the variability of naturally occurring suspended particulate matter concentrations.

- In general, the amounts of additives in the other discharges are expected to be relatively small (from 4 to 400 or 800 liters per month) and diluted with sea water several hundred to several thousand times before being discharged into the receiving waters.

- The nonvolatile hydrocarbons (oil and grease) in produced waters from an existing oil production platform would be diluted a thousandfold within several hundred meters. At a 1,000:1 dilution, the concentrations of nonvolatile hydrocarbons would reduce from 29 parts per million to 29 parts per billion within several hundred meters of the platform, and the concentrations of total aromatic hydrocarbons might range from 8–13 parts per million close to the platform and 8–13 parts per billion within several hundred meters of the platform.

10.3 CRITERION 3

The composition and vulnerability of the biological communities that may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain:

- Low concentrations of BOD and nutrients in sanitary waste discharges could stimulate primary productivity and enhance zooplankton production. This effect is predicted to be negligible.

- Threatened and endangered species that could occur in Cook Inlet include chinook salmon, sockeye salmon, short-tailed albatross, Steller's eider, blue whale, fin whale, humpback whale, northern Pacific right whale, Sei whale, sperm whale, Steller sea lion, and northern sea otter. Most of these species are not likely to use water close to permitted activities or are unlikely to inhabit Cook Inlet waters; they are unlikely to be affected by discharges from oil and gas exploration, production, and development facilities in Cook Inlet.
- The Steller sea lion has designated critical habitat within the geographic area of coverage for the proposed NPDES general permit but critical habitat restrictions do not allow discharges in the vicinity of Steller sea lions. In addition, rapid dilution and low toxicity of drilling fluids discharged to Cook Inlet imply that these discharges would not be likely to adversely affect pollock or other Steller sea lion prey. Pollutant concentrations in mixing zones complying with chronic water standards are not expected to adversely affect Steller sea lions in Cook Inlet.

- Drilling fluid discharges in Cook Inlet could alter prey available to the northern sea otter in the immediate vicinity of the discharges through burial of benthic organisms or changing bottom habitat characteristics. Exposure to pollutants within mixing zones and exposure to discharged water complying with chronic water standards is not expected to adversely affect northern sea otters.

- Beluga whales have been identified as depleted under the Marine Mammal Protection Act. Drilling fluid discharges in Cook Inlet could adversely affect prey availability in the immediate vicinity of the discharges because of the burial of benthic organisms, or changes in bottom habitat characteristics, but such effects would be of limited size and duration. The discharges authorized under the proposed NPDES general permit may affect individual beluga whales either directly or indirectly; however, they are not likely to contribute to a further decline of the Cook Inlet beluga whale stock or affect the recovery of the population as a whole.

10.4 CRITERION 4

The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism:

- Anadromous fish migrate through Cook Inlet towards spawning habitat in rivers and streams, and juveniles travel through Cook Inlet toward marine feeding areas. Habitats of potential concern (HPCs) within essential fish habitat (EFH) in Cook Inlet are the estuarine and nearshore habitats of Pacific salmon (e.g., eelgrass [*Zostera sp.*] beds) and herring spawning grounds (e.g., rockweed [*Fucus sp.*] and eelgrass). Offshore HPCs include areas with substrates that serve as cover for organisms including groundfish. All anadromous streams qualify as HPC. The Susitna River drainage is a primary source of these anadromous fish in Cook Inlet. Eulachon also return to spawn in some of the rivers. Because the waste discharges will either be injected or will be rapidly dispersed, it is unlikely that they would adversely affect migrating anadromous fish.

- Cook Inlet is an important area for marine mammals including beluga whales, Steller sea lions, and harbor seals. No adverse impacts from the waste discharges from the oil and gas exploration, development, and production facilities in Cook Inlet are predicted.

- Lower Cook Inlet is one of the most productive areas for seabirds in Alaska, with an estimated 100,000 seabirds; 18 species breed in Cook Inlet.

- Waterbirds and waterfowl breed in the Cook Inlet region. In spring, large numbers of waterbirds migrate through the area. Large populations of staging waterfowl are found in tidal flats, along river mouths, and in bays on the west side of the inlet, including Redoubt Bay. Redoubt Bay has especially high concentrations of geese and ducks.

- Due to the injection of waste streams or rapid dispersion of waste discharges from the oil and gas exploration, development, and production facilities in Cook Inlet, no adverse impacts on birds are predicted.

10.5 CRITERION 5

The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs:

The following SGRs, SGSs, CHAs, National Park, and AMSAs are in the proposed NPDES general permit coverage area:

Palmer Hay Flats SGR	Kachemak Bay CHA
Kalgin Island CHA	Lake Clark National Park
Susitna Flats SGR	Goose Bay SGR
Anchorage Coastal Wildlife Refuge	Clam Gulch CHA
Port Graham/Nanwalek AMSA	McNeil River SGS
Trading Bay SGR	Redoubt Bay CHA
Potter Point SGR	

The facilities covered under the proposed NPDES general permit are not within and these facilities are prohibited from discharging to any of these areas, SGRs, SGSs, CHAs, National Park, or AMSAs. Due to the relative low toxicity of waste discharges from platforms in Cook Inlet and the rapid dispersion of pollutants in these waste discharges, no adverse effects are predicted.

10.6 CRITERION 6

The potential impacts on human health through direct and indirect pathways:

- There is no known direct exposure pathway to humans from the discharges associated with oil and gas exploration in Alaska; indirect exposure is primarily from direct consumption of species exposed to discharges.

- Increases in metal body burdens of animals consumed by humans that are attributable to drilling fluid discharges are expected to be minor, but metal content of drilling fluids and other discharges from oil and gas exploration, development, and production facilities should be minimized through adherence to the effluent limitations in the proposed NPDES general permit to decrease the amount of heavy metals discharged to Cook Inlet.

- Most contaminants detected in Cook Inlet fish are less than or comparable to contaminants detected in regional or national studies.

- Permitted discharges from the existing and new oil and gas platforms in Cook Inlet are minimally toxic; therefore, adverse human health effects are unlikely to result from Cook Inlet exploration, development, and production discharges.

10.7 CRITERION 7

Existing or potential recreational and commercial fishing, including finfishing and shellfishing:

The routine activities associated with exploration, development, and production in the area covered by the proposed NPDES general permit are predicted to have insignificant impacts on the quantity or quality of the commercial, recreational, or subsistence harvests in Cook Inlet on the basis of the potential effects of disturbance on subsistence resources, the mobility of harvested species, the potential effects of permitted discharges on water quality, and the rapid dilution of discharges by the strong tidal flux of Cook Inlet.

10.8 CRITERION 8

Any applicable requirements of an approved Coastal Zone Management Plan:

Waste discharges associated with oil and gas exploration, development, and production facilities in Cook Inlet are expected to be consistent with relevant Alaska Coastal Management Program policies and with the Kenai Peninsula Borough Coastal Management Program.

10.9 CRITERION 9

Such other factors relating to the effects of the discharge as may be appropriate:

No other factors have been identified relating to the effects of the discharge.

10.10 CRITERION 10

Marine water quality criteria developed pursuant to Section 304(a)(I):

- To promote better compliance with the oil and grease limit, the proposed NPDES general permit includes a new produced water prohibition for new sources in territorial waters.
- The discharges from oil and gas exploration, development, and production facilities in Cook Inlet are expected to comply with all marine water quality criteria.

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